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ABSTRACT

An 18-month study examined the impact of word processors on the teaching and learning of writing in an area school on the South Island of New Zealand, with a special focus upon the writing development of 9 primary school children ranging in age from 8 years 11 months to 11 years 8 months. A wide range of data was collected on each pupil, including test scores, responses to questionnaires on writing and the use of the word processor, diary comments, and notes from formal observations. The teachers also maintained diaries, and regular meetings each term were held by the researchers and teachers to discuss progress with the study. Pupils' writing samples, both handwritten and word processed, in draft and in final form, were gathered regularly and analyzed by experienced classroom teachers. Results indicated that most of the case study pupils improved their writing, but the pattern of development varied from pupil to pupil and was inconsistent even for the same pupil. Results also indicated no noticeable improvement in students' spelling because of the availability of the spell checker. Findings suggest that it is unlikely that improvements in pupils' writing could be attributed to use of the word processor. However, word processors may have provided a positive boost for some pupils, and were generally considered in a favorable light by teachers. (Contains 28 references and 2 tables of data. Appendixes contain three questionnaires, instructions to pupils about keeping a diary, and an observation guide for the case study pupils.) (Author/RS)

CS

Evaluation of Exploratory Studies in Educational Computing

USING THE WORD PROCESSOR TO DEVELOP SKILLS OF WRITTEN EXPRESSION

New Zealand Council for Educational Research

Evaluation of Exploratory Studies in Educational Computing

STUDY 6:

USING THE WORD PROCESSOR TO DEVELOP SKILLS OF WRITTEN EXPRESSION

FINAL REPORT

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ABSTRACT

This report describes the results of an 18-month-long study of the impact of word processors on the teaching and learning of writing in an area school in the South Island, with a special focus upon the writing development of 9 primary school children. From the first term of 1986 until the end of the second term 1987, 4 classes ranging from standard 3 to form 3-4 had the opportunity to use word processors for regular timetabled sessions.

A wide range of data was collected on each pupil, including test scores, responses to questionnaires on writing and the use of the word processor, diary comments, and notes from formal observations. The teachers also maintained diaries, and regular meetings each term were held by the researchers with the teachers to discuss progress with the study. Pupils' writing samples, both handwritten and word processed, in draft and in final form, were gathered regularly. These were analysed after the study concluded by 2 panels of experienced classroom teachers, meeting early in 1987 and in 1988.

The results from the qualitative data show that most of the case-study pupils improved in their writing during the study, but the pattern of development varied from pupil to pupil and was inconsistent even for the same pupil. It is unlikely that the improvements shown in the pupils' writing, where these occurred, could be attributed solely or largely to the use of the word processors. There did not appear to be a noticeable improvement in students' spelling because of the availability of a spelling checker. However, the word processors may have provided a positive boost for some pupils, and were generally considered in a favourable light by their teachers.

CONTENTS

PREFACE

The Exploratory Studies in Educational Computing (ESEC) were requested and funded by the New Zealand Minister of Education in 1985. The purpose of the studies was to provide a basis for future policy developments in educational computing.

Initial proposals were sought in an advertisement in the *Education Gazette* of 14 June 1985, and some 200 separate proposals from more than 100 schools were received. A broadly representative conference met at the Stella Maris Retreat Centre, Wellington, between 2-6 September 1985 to consider the applications, and eventually 15 distinct studies for major funding were chosen. Subsequently 2 of these were subdivided, making 19 separate studies in all.

The Computers in Education Development Unit (CEDU), within the Department of Education, was responsible for the technical management and funding of the projects, and with the exception of 1 study, the New Zealand Council for Educational Research has been responsible for their evaluation. Each evaluation was co-ordinated and conducted by a committee consisting of the teachers involved (who were often, though not always, the originators of the study), 1 member from the CEDU, at least 1 member from the NZCER, and often others from the inspectorate, teachers colleges, or regional resource centres.

Many of the proposals had requested specific computer equipment and software, and this was ordered and shipped to schools by the beginning of 1986. Classroom computer work commenced at various times during 1986, and proceeded through 1987. Various research materials were prepared for use as required by all the studies, including pre- and post-questionnaires for students and teachers, and logs and diaries to record day-to-day impressions. In addition, study-specific instruments were prepared where necessary. One of the studies was at the preschool level, and 4 studies dealt with children with special needs. All of the remainder were located in primary schools, but some involved secondary school children as well.

The projects were distinctive in the way in which they had been initiated by classroom teachers, rather than by policy makers or educational researchers. The level of commitment from all the teachers involved in the projects was consequently very high. They responded positively to the opportunity to participate, and contributed many hours of extra work to the evaluative aspects of the studies.

The study reported in the following pages, study No. 6, involved teachers from 1 school in the South Island: Maniototo Area School in Ranfurly. Special thanks are due to Ann Frampton of the former Department of Education's Computers in Education Development Unit, Angela Varelas and Christine Wilson, former research assistants involved with the analysis of the data, Stephen French who was the proposer of the study and the on-site co-ordinator while the study was being carried out, and the teachers and students who took part. Because of the detailed nature of the case studies reported, real names have not been used in order to preserve teacher and student confidentiality.

David Philips

1 INTRODUCTION: COMPUTERS AND WRITING

Not everyone writes and many people write very little. Yet learning to write is often hailed as the cornerstone of a successful education. One could go further and argue that, despite the technological advances of recent decades, modern society depends upon a writing system which is accessible to all. Nearly 15 years ago, Whiteman (1980) claimed (p. 151) that:

> . . . with all the accumulated knowledge about writing, we still know hardly anything about **how** people learn to write, what composing processes they use, whether or not there are any natural stages of development, or whether adults differ from children in such learning. Nor do we know how best to facilitate the learning of writing in schools.

While some of his observations are still valid, since 1980 researchers have increasingly addressed these very issues. Flower and Hayes (1981, 1984) at Carnegie-Mellon University, with their studies of the composing processes of university students, Bereiter and Scardamalia (1987) at the Ontario Institute for Studies in Education, investigating the development of writing in school-age students in different areas of the curriculum, and numerous others, have investigated the composing process, effective ways of teaching writing and, in some cases, the role of computers in aiding writing development.

A variety of approaches have been taken in research on writing. There have been detailed case studies of individual writers (e.g., Bissex, 1980), surveys of large groups of writers (e.g., Lamb, 1987), studies using protocol analysis (e.g., Swarts, Flower, and Hayes, 1984), text-based studies (e.g., Harris and Wilkinson, 1986), ethnographic studies (e.g., Heath, 1983), and so on. Much of this research focuses on how writers cope with different aspects of the writing process such as revising (*see*, for example, Graves, 1983).

Interest in the role which word-processing programs might play in promoting the development of writing skills occurred increasingly through the 1980s as part of a wider development of research on the teaching and learning of writing, and as part of a shift away from seeing computers as relevant only to mathematics and science instruction (*see*, for example, Bruce, Michaels, and Watson-Gegeo, 1985). While early research focused on the usefulness of different word-processing programs for writing, few studies were carried out which focused on how students in primary schools used the computer and whether their writing improved as a result. Barker (1987) provides a useful overview of the focus of these studies, looking at the effects of word processing on writing instruction, the attitudes of writers using a word processor towards writing, composing behaviour, and revising practices.

Many claim that computers can actually help to improve pupils' writing skills because they remove many of the obstacles some pupils face with pen(cil)-and-paper writing methods, such as illegibility or incorrect spelling or unattractive layout, and assist therefore in building the self-esteem of these pupils. Others have claimed that, once pupils have mastered the computer's keyboard and operating procedures, they work faster and more efficiently in their writing than with more traditional methods, and edit or revise their written work more effectively.

As Philips (1986) states, there are at least 5 advantages:

- the writing looks more professional;
- mistakes can be corrected without making a mess;
- painstaking rewrites are banished;
- revisions can be made more easily; and
- pupils can share the writing task with each other.

Another of the "Exploratory Studies in Educational Computing" series has examined the issues associated with collaborative activities in writing stories (Ashworth and Atmore, 1989).

These advantages are now well attested (*see*, for example, Kamler and Woods, 1987) and reflect the optimism which greeted the increasing use of computers in schools in the early 1980s. Chandler (1985), for example, states (p. 10) that computers "are ripe for hijacking as subversive devices by enlightened educators concerned with increasing the autonomy of children as learners. The use of the computer as a writing tool is an outstanding example of such a liberating application."

In *Young Learners and the Microcomputer* Chandler notes (p. 35) that "The word-processor can help . . . [pupils] get started and keep going. They need not be inhibited by the thought of making mistakes: there's no longer the same kind of 'risk' in committing themselves." According to Chandler (p. 4):

> There seems little doubt that computers can make writing far more accessible to children. . . . many young children report that they find the word processor a far easier tool to handle than the pen, and their efforts are, of course rewarded with very presentable results. Text produced using a word-processor can look as good as the text in a printed book, and this is an important factor in reducing the gap which children perceive between their own writing and the printed book. The editing facilities of word-processors also offer a far more supportive environment for drafting than pen and paper, and can encourage children to improve the content as well as the appearance of their writing (although some observers have suggested that children may concentrate on low-level editing even with word-processors).

According to Clark (1985), a printed version of the pupil's writing (p. 19) -

> . . . distances the writer from the act of creation - however modest that act might be. With distancing comes the ability to exercise an editorial function more dispassionately. Critical observations become precise and exact. It is, of course, far easier to see a mistake (and more difficult to conceal one). But since it is so easy to correct errors, pupils become more ready to admit that the mistakes exist. . . . Suddenly, punctuation becomes of real interest. It is a delight to listen to 7-year-olds arguing over the alternative positions for speech marks or an impassioned defence of the placing of a comma - and it does happen.

But not all students are affected in the same way by word processors. A note of caution is sounded by Chandler (1984), who observes (p. 36) that "research by Colette Daiute . . . suggests that 'some young writers work more creatively when they use word processing programs than when they use pens, but the computer makes no difference or is limiting for others' ".

As Morton, Lindsay, and Roche (1989) note (p. 147), "The tedium associated with error corrections, text modifications (changes, additions, deletions, etc) and subsequent drafts is eliminated". Their study showed that students who were assigned to a word-processing session produced more draft copies of revised texts, more stories and more words, in total output, and that the production of final drafts, at least for fifth graders, was facilitated. It is generally accepted, therefore, that word processors have a number of advantages over pen-or-pencil approaches towards writing. Macarthur (1988) describes the power and flexibility which word processors bring to writing instruction.

There is little doubt now that computers can play an invaluable role in learning, and that they are an extremely useful tool, not just for enhancing writing but for problem solving and other higher order learning skills across the curriculum. Rowe (1993), for example, has provided an extensive account of the SUNRISE project in Australia, an empirical study of 115 grade 6 and 7 students and positive ways of integrating computers into teaching and learning across the curriculum.

In addition to research on writing (*see*, for example, Philips, 1985, and O'Rourke and Philips, 1989), during the mid-80s to the early 90s there were various initiatives set up by the Department of Education and, in some cases, continued by the Ministry of Education, to encourage teachers to develop their awareness of effective practices for teaching and assessing writing, such as the Writing Project (*see* Catherwood, 1987, and Pritchard, 1987), and the support provided by the Computers in Education Development Unit to the use of computers in schools, including their use in English classes. Some of this research, including studies

undertaken in New Zealand, has been mentioned in a recent resource on writing for primary teachers, *Dancing with the Pen*. In the late 1980s, some of the Exploratory Studies in Educational Computing which were conducted on behalf of the Department of Education focused specifically on the use of computers, particularly in primary schools.

As a result of the extent to which computers have been adopted by schools, and the generally positive findings from research, computers in schools now have a well-established place. However, a major question which has received little attention (though *see* Snyder's (1992) study of 13-year-olds using word processors which showed improved quality of writing) by researchers is "Does word processing improve students' writing?" So rather than assuming that all pupils will benefit equally from the use of word processors, it was considered worthwhile to investigate their use for writing in order to determine whether pupils differ in their approaches. The study described in this report shows how 9 pupils approached the use of writing with word processors, and comments upon the impact of the word processor on the quality of their writing over a period of about 1½ years.

2 AIM OF THE EVALUATION

The present study seeks to examine how the use of a word processor affects the writing of students across a variety of class levels. In its broadest sense, the aim of the study was to determine whether using a word processor in an area school (i.e., one where children of primary and secondary ages are combined in a single school because of relative isolation and small numbers) alters students' approaches towards writing, and to describe any changes observed.

When the study was originally conceived, the objectives were:

- to compare the attitudes towards writing of students using word processing within classes at levels from standard 3 to form 4 with those in other classes at similar levels adopting more traditional approaches to writing (i.e., who were not using a word processor in their classrooms);

- to compare the quality of writing and the writing-process skills of the students using word-processing technology with those following a pen(cil)-and-paper approach at similar class levels;

- to assess whether students using a word-processing program with a spelling-check program and dictionary improve their spelling performance; and

- to determine whether students using a word-processing program with a spelling-check program and dictionary use a greater variety of words or a larger number of words than those using a more traditional approach.

As the study progressed, more attention was paid to the attitudes of particular pupils as they changed over time, and less attention to those who wrote with a word processor compared with those who did not. It also became clear that it would be more useful to track changes - where they could be discerned - in the writing of particular students, and that this would be more valuable, because of the insights provided into students' writing behaviour, than a series of statistical comparisons based upon repeatedly administered questionnaires.

While quantitative studies such as that by Morton, Lindsay, and Roche (1989) have established that the quality of students' writing when using a word processor improves, it is not clear how using a word processor affects individual students and whether the patterns of improvement vary from student to student. So for specific pupils in this study the word-processed writing is compared with their pen-and-paper writing, rather than comparing whole classes writing with different technologies. This was done partly because of the richness of the data available on individual pupils and because of resource constraints which prevented the marking of hundreds of separate scripts and analysis of hundreds of questionnaires in order to compare whole classes.

The first 2 objectives were therefore modified to focus upon the same students, rather than experimental and control-group comparisons. Problems with the spelling checker (i.e., most students appeared to use it very inefficiently, partly because of limitations in the spelling checker itself, and partly because most of the students who lacked sound dictionary skills were unable to use what was in effect an on-line dictionary without meanings) meant that the third and fourth objectives assumed less importance in the study. Nevertheless, some observations are made on the use of the spelling checker and changes in the amount of writing done by the students during the study.

3 THE RESEARCH PLAN

Sample

The School

Maniototo Area School is approximately 2 hours by car from its closest major city, Dunedin. The school was established in 1969 as 1 of 2 pilot area schools, and provides education for pupils from J1 to form 7 for children in the small town in which it is located and from the surrounding district. It had a total role of about 290 during the period of the study. The staff consisted of a principal, deputy principal, 6 senior teachers, 11 other full-time teachers and 5 part-time teachers.

The district is a rural grazing area. The principal types of employment are therefore farming and service occupations. Although the community has tended to be reasonably stable within business and professional sectors, there has been more mobility within the government, transport, and farm work sectors, and there was a concern at the time of the study that the increasing pressure placed upon rural communities throughout New Zealand in the mid to late 1980s would result in a faster rate of depopulation than in previous years. To some extent this concern has now abated.

The Classes

In 1986 six classes were involved in the study, with 4 using word processors and 2 serving as control groups. The 4 experimental classes were:

- A standard 3 class (without a control group), consisting of 20 children (13 boys and 7 girls) of medium ability apart from one outstanding reader.
- A standard 4 class (without a control group), with 29 children (17 boys and 12 girls) and a wide range of ability.
- A composite form 1-2 class (with a control group) of 25 pupils (7 form 1 boys, 5 form 1 girls, 6 form 2 boys, and 7 form 2 girls) with a wide range of ability.
- A composite form 3-4 class (also with a control group) with 23 pupils (5 form 3 girls, 4 form 3 boys, 5 form 4 girls, and 9 form 4 boys), also varying in ability.

In all classes, according to the teachers, there was a high degree of parental support and interest.

Because of changes in teaching staff between the 2 consecutive years of data gathering, and the fact that some older students were no longer in the study group by the end of the second year, it was not possible to make detailed comparisons of the writing performance of all the groups of students as intended in the original objectives of the study. However, data are provided on the views of the teachers over the 2 years, despite changes in the teachers responsible for the classes involved in using the word processors for writing.

The 2 control classes (a form 1-2 and a form 3-4) were carefully chosen to match the experimental classes at these levels in terms of social and ability variables.

The Case-study Pupils

A sample of 9 children was selected for special study, consisting of 3 pupils from each of the experimental classes, with the exception of the form 3-4 class as the majority of the pupils did not participate in the study in their form 5 year. From each class a competent writer, an average writer, and a writer experiencing difficulties were chosen. The choice of pupils was left up to the teacher, provided that those chosen met the

criterion of a range of ability based upon previous records (e.g., performance in standardised tests, particularly the Progressive Achievement Tests of Listening Comprehension, Reading Comprehension and Reading Vocabulary; *see* Table 1) of the pupils' achievement: 6 boys and 3 girls were selected. All of the writing produced by these pupils was saved for research purposes, both on disk and in printed format.

Table 1

Case-study Pupils: Standardised Test Scores

Pupil	Year	PAT:LC	PAT:RC	PAT:RV
Godfrey	'86	80	80	80
	'87	90	90	90
Teri	'86	69	49	44
	'87	56	60	72
Michael	'86	30	43	17
	'87	na	9	41
Sharon	'86	80	95+	95+
	'87	na	na	na
Sean	'86	56	62	47
	'87	46	60	50
Thomas	'86	36	23	41
	'87	45	34	45
John	'86	na	71	77
	'87	22	50	55
Laura	'86	50	65	44
	'87	30	51	45
Eric	'86	31	6	na
	'87	na	na	na

Godfrey was aged 8 years 11 months at the beginning of 1986. He was considered to be an active and able pupil who enjoyed finishing work before others. He was very enthusiastic about the computer, proficient in its use, and often the first to arrive to use it. Over 1986, his teacher thought Godfrey's writing improved and that most of his mistakes were due to carelessness.

Teri was aged 9 years 2 months at the beginning of 1986. She was considered to have a short attention span and to work slowly, but she was "fanatical" about tidiness. She had difficulty with spelling though made a determined effort to check words, and took a long time to become independent with the computer and to produce draft copies.

Michael was aged 8 years 8 months at the beginning of 1986. Initially he was reticent in the class but became more talkative. He settled down to work satisfactorily and, though initially slow with the computer, enjoyed using it. His 1986 teacher considered that Michael's writing required a lot of editing.

Sharon was aged 10 years 3 months at the beginning of the study. Her 1986 teacher considered Sharon to be perceptive and incisive with an obvious flair for writing, as well as technical competence. She quickly understood procedures for using the computer and enjoyed proofreading her own and others' writing, and reading printouts.

Sean was also aged 9 years 11 months at the beginning of 1986. His 1986 teacher noted that Sean was a shy member of the class. He quickly adapted to the keyboard, though his writing was considered unstructured.

Thomas was aged 9 years 11 months at the beginning of the study. His teacher in 1986 considered Thomas to be easily distracted, though he enjoyed drawing and liked using the keyboard. By the end of the year the teacher thought that he was possibly more aware of sentence structure and spelling.

John was aged 12 years 5 months at the beginning of the study. His teacher in 1986 considered that John quickly became acquainted with how the computer worked, that he enjoyed using it though he preferred short pieces of writing, and that he may have improved slightly over the first year of the study.

Laura was aged 11 years 11 months at the beginning of the study. Her 1986 teacher considered that Laura enjoyed class discussions. She also enjoyed using the computer but usually only used 1 finger. The teacher was uncertain whether Laura's writing improved over the year and considered that she did not like using the spell-check facility.

Eric was aged 11 years 8 months at the beginning of the study. His teacher in 1986 described Eric as struggling with spelling and handwriting, producing short stories in pencil. He took some time to become used to the computer, repeatedly making basic mistakes, but gradually improved as he paid more attention to rereading his writing. He enjoyed using the computer, though he preferred playing games to writing.

Equipment and Instruments

Hardware

The hardware provided by the Department of Education was 10 Apple 11e 64k single-disk-drive computers with green monitors and an Apple-compatible parallel printer. All machines were deployed in a room especially put aside for the purpose, and classes were timetabled for computer use.

Software

During the pre-experimental phase, Zork 1 was used to assist the pupils in becoming familiar with the keyboard and appropriate commands, while for the experimental phase of the study Fulltext 55/80* was provided. However, during the early part of 1987 another shift was made, this time to Fulltext Pro80,* because this version had more features (e.g., extra fonts) which allowed more diverse styles of presentation.

Instruments

Several instruments were designed specifically for use in this study, ranging from questionnaires about writing to pupil diaries and observation guides. In addition, several kinds of test results were collated for each pupil at the beginning of each of the 2 years of field work or at other appropriate intervals, depending upon the nature of the test, and the teachers taking part were asked to keep an informal diary.

* This word-processing programme, which was commonly used for the duration of the study, will have been superseded in many schools.

The 3 questionnaires were:

- The "Attitudes towards Writing" questionnaire (AWQ);
- The "Writing with a Word Processor" questionnaire (WWPQ);
- The "Teaching Writing with a Word Processor" questionnaire (TWWPQ).

Each was designed to obtain information about particular aspects of the pupils' or teachers' experiences of, and perceptions about, writing or the use of word processors. The AWQ and the WWPQ were designed for the pupils, and administered at several points during the project, while the TWWPQ was designed for the teachers to complete. The questionnaires use a mixture of open-ended and forced-choice questions. [*See* Appendices A, B, and C respectively for copies of these questionnaires.]

Pupils were asked to keep a diary as a record of their use of the word processor, and instructions (reminder questions) were taped to the inside cover. The instructions, "Keeping your Computer Diary", are in Appendix D.

An observation check list [*see* Appendix E] was designed. Three times during the study, at equal intervals, the co-ordinator observed the case-study pupils while they wrote at the computer, and made notes on each of the aspects listed in the check list:

- ☐ assistance given to the pupil while observed,
- ☐ assistance given by the pupil to another pupil,
- ☐ time spent on-task and off-task,
- ☐ changes made to the pupil's writing,
- ☐ presentation,
- ☐ confidence in using word processing procedures,
- ☐ comments made by the pupil while writing,
- ☐ use of the computer log,
- ☐ speed of writing, and
- ☐ difficulties while writing.

Each time the comments were about 1 page long.

Procedure

General Procedure and Time Frame

Apart from the form 3-4 class (3 periods), each class was scheduled for 4 periods per week on the computers, so each student had about 60 minutes per week. Each class was divided into 2 groups who spent half the time writing with computers (i.e., using a word-processing and associated spelling-check program [Fulltext 55/80] during their written language programme to create, edit, check, and publish written work) and the rest participating in other writing-related activities.

Teacher strategies occasionally varied, as different combinations of time (e.g., 1 period on, 1 period off), and various strategies of classroom management were adopted. Later in the study some teachers returned to earlier routines, while others were more flexible; for example, occasionally when 1 pupil in the first group had finished a particular activity before their allotted time was up, the next pupil could start using the computer earlier and spend more time using it for that session. The control groups were timetabled for 2 periods each week with another computer activity (e.g., Logo), and followed a similar written-language programme without using a word processor.

During term 1, 1986, both experimental and control groups used the computer with non-word-processing, language-orientated software (such as adventure games) to become familiar with the technology and the keyboard. Prior to this 4-week period, the participating teachers had time to use the word-processing software to become acquainted with it (through exercises for practising retrieval of text from disk, insertion and deletion, paragraphing, and later, dictionary use). Ongoing assistance was provided in the first term and later by the teacher who prepared the original proposal. Three pieces of writing (a story, a description, and

a letter) produced as part of the normal class programme were also collected from each pupil. Each teacher completed a questionnaire on their attitudes towards the teaching of writing, and the approaches adopted in their classroom.

During the experimental phase until the end of term 2, 1987, all pupils in the experimental and control groups completed PRETOS (Proofreading Tests of Spelling) at the appropriate level or, if in form 3-4, a spelling test administered as part of the Pathways to Employment Project; the Progressive Achievement Tests usually administered in the school (Reading Vocabulary, Reading Comprehension, Listening Comprehension, and parts of the Study Skills series); and the AWQ, administered before word-processing activities began.

As in term 1, three pieces of writing - a story, a description, and a letter - were also collected from each pupil, both at the end of November 1986, and at the end of July 1987. PRETOS was also administered twice more.

Throughout the experimental phase of the study, pupils and teachers maintained their diaries.

Observations of the Pupils

At specified intervals an independent observer came into each classroom and formally observed the 9 case-study pupils individually, using the observation guide. Each of these pupils was observed by the study co-ordinator 3 times: in term 2 and term 3 1986, and in term 2 1987.

Teachers' Perceptions

Each teacher completed a questionnaire on the use of the word processor on 3 occasions. The pupils were regularly observed, informally, by their usual teacher to capture perceptions of how well their pupils coped with the computers, or how they reacted to a particular task while using the computer. After an initial bout of enthusiasm, diary comments on their reactions to the presence of the word processors in their classrooms, on their use (their own or their pupils'), and any difficulties encountered were made intermittently.

Pupils' Perceptions

The pupils in the experimental classes were also asked to keep diaries, entering the time spent on the word processor, what they did while using it, and comments on their word-processed writing. A pupil log - a record of the times pupils used the computer - was also kept. On 3 occasions each pupil completed a questionnaire on their reactions towards the use of the word processor. The questionnaire on attitudes towards writing was also completed on a further 2 occasions, after its first administration in the pre-experimental phase.

Writing samples

Nine samples - some drafts, some final copies - of word-processed writing were collected altogether at regular intervals (*see* Table 2). We felt that it was important to see how pupils wrote with the word processor over a school day, and wanted to see "first attempts" as well as final, edited versions which might have reflected their teacher's influence.

The pupils were probably allowed more time for the word-processed pieces, in part because the study focused on writing with computers, and in part because they were available for set periods which may have encouraged teachers to allow pupils to concentrate longer on written work than in their normal classroom. It is not possible, therefore, to make direct comparisons between the handwritten samples and the word-processed ones, although some trends can be noted.

An overview of the times when the various types of information were gathered is provided in Table 2.

Analysis

The rest of this report describes how the case-study pupils used the word processor for writing, and compares

their writing using a pen(cil) with word-processed writing. Pupils' attitudes over the period of the study, as identified through responses to the questionnaires "Attitudes towards Writing" and "Writing with a Word Processor", are also examined, and an assessment offered as to whether their writing improved and the word processor's possible contribution. Panels of experienced primary teachers analysed the pupils' handwritten and word-processed writing, and noted any developmental trends. Diary comments and observations have also been taken into account.

Table 2

Data Collection Timetable

Time	TWWPQ	AWQ	WWPQ	W/PR*	H/WR*	OBS*
1986						
February						
March						
April		x		draft	x	
May	x		x			
June				draft		
July				final		x
August						
September						
October				draft		x
November	x	x	x	final	x	
December						
1987						
February						
March				draft		
April				final		
May						
June				draft		x
July	x	x	x	final	x	

* W/PR=word-processed writing sample
H/WR=handwritten writing sample
OBS=formal observation

4 THE PUPILS' WRITING WITH A WORD PROCESSOR

The Case-study Pupils

Detailed accounts of the 9 case-study pupils are provided here. The dates in brackets, when given, refer to a diary entry or observation.

Godfrey (Standard 3-4)

His 29 diary entries for 1986 are generally brief. His comments refer to specific activities (e.g., "Finished story Police Pets" [6.5.86]), but in June he made the observation: "Need more time to do story. Wish I had more time. I'm starting to hate computer time." [6.6.86] This response seemed to be atypical, however. Other responses are more analytical, for example, "Middle of new story. Hands getting sore when using computer but I still like it because you don't have to write a story all over again." [17.7.86]

In 1987, 120 entries are made in the diary over the year. His diary entries make fascinating reading, as he updates progress with his stories and other computer activities. He is a classroom "expert", who enjoyed helping other pupils, particularly with the word checker, saving to disk, and the printer (e.g., "Helped Tim to use word checker and helped him with words." [16.2.87]; "Helped Emma and Julie print." [5.3.87]); and he referred to the advantages of Fulltext soon after it was introduced in April 1987: "Was going to help Michael with new f.t. but disk wasn't ready for it. This f.t. is better because you can do different printing with it. I can do everything on the new fulltext." [24.4.87] and "Like the bold enlarged printing." [6.5.87] He is pleased when things go right, for example: "Finished story and checked through it. Only had 5 spelling mistakes out of 286 words." [7.5.87]; and refers to changes in the teaching programme: "I like working with a partner as they have more ideas." [2.7.87]

His responses to the "Attitudes towards Writing" questionnaire show that by the end of 1986 writing was his favourite school activity, and that he could write for a long time without becoming bored, unlike earlier in the year. He liked helping his friends to improve their writing, and thought that writing helped him to learn more, whereas earlier in the year he had been either unsure or disagreed with these statements.

At all times he claimed to check his writing for spelling mistakes; his diary confirms regular use of the word checker, and his writing had few spelling mistakes compared with other pupils in the study. His PRETOS results suggest that he is a good speller, with percentile ranks usually in the 80s and 90s.

According to the first panel of Wellington teachers, Godfrey's February handwritten pieces contained sound though often unconnected ideas. For 2 of the 3 samples, language usage and sentence structure were accurate, apart from the occasional misspelling. The description contained simple vocabulary and sentence structure. The November pieces - especially the story - appeared to use a wider range of skills, were better organised, and again were reasonably accurate in language usage.

The handwritten pieces 8 months later, in July 1987, show some differences from the 1986 samples. Although both the story and description are shorter, the letter is over 50 words longer. All are broken into indented paragraphs, unlike the earlier samples, with clear topics in each. Information presented is interesting and well ordered, and in the story humour is used to good effect. Punctuation is used accurately, with a wide variety of conventions; dialogue introduces the story by setting the scene, and the description is enlivened by the use of commas to separate adverbial phrases and to emphasise the order in which things are done.

Regarding word-processed writing, by the end of 1986 Godfrey agreed that he enjoyed writing with the word processor, including adding and removing words from his stories. He retained similar views in 1987. However, he was unsure whether the word processor was helping to improve his writing. By mid-1987, however, he indicated that he did not think his writing was getting better because of the word processor. By the end of the study he felt that his classmates and his own experience were more useful sources of information than his teacher about the word processor, rating classmates higher than previously.

The writing samples produced with the word processor, a mixture of drafts and final versions, are considerably longer (up to 750 words) than any of the handwritten pieces, especially those written in 1986. The initial word-processed pieces were inventive, with elements of fantasy, but suffered from an unclear direction, lack of varied sentence structure, and occasional inaccurate language usage, especially in the drafts. It is difficult, therefore, to tell whether his word-processed writing developed over the first year, except perhaps in its length.

The pieces collected in 1987 used varied sentence structure and were generally accurate in language use and punctuation. The last 2 pieces both begin with dialogue and are imaginative treatments of what might have been ordinary events: a flight in an aeroplane, and a parade. "My Trip over Alexandra" turns into a balloon flight and uses some interesting words (e.g., gargantuan). Minor finetuning is all that is required to create technically accurate pieces of writing.

My Trip Over Alexandra

"Mum, may I watch the floats and put in a vote?" requested Jeff.
"I suppose you can, but don't run through the crowd like you did last time."

But before she could say anything else, Jeff was up and running through the crowd like they weren't there. On the way Jeff noticed a balloon seller. He sold gargantuan gas ones, and they were all different colours. Jeff decided to buy a couple, so up he went with his money and bought a couple.

But as soon as he grabbed hold of them, he was soaring above the heads of the people. Since there was not a breath of wind he just went up and up. It was a wonderful view but Jeff's knees were knocking, his teeth were chattering, and in general he was dead scared. . . .

His 1986 writing shows considerable experimentation with everything he thinks of being entered on to the computer, while the 1987 samples are more polished though still highly imaginative. There appear to be few if any differences between the handwritten and the word-processed samples of writing; all the final pieces from the end of the second term of 1987 are assured in content and technique.

Three formal observations were made: on 17 June 1986, 18 November 1986, and 25 June 1987. As with the other case-study pupils, these were carried out by the study co-ordinator. Godfrey was on-task every time, confidently used word-processing procedures (e.g., many of the special features such as italics, bold, and enlarged script), and encountered virtually no difficulties. As the co-ordinator's last observation record states:

> Godfrey was able to write with ease. The ideas flowed so easily that he never paused for reading back what he had written. He had plenty of ideas, good vocabulary and spelling, and layout and punctuation came naturally. It seemed no time before he had written enough to fill several screens with text, and still the ideas were coming. Changes were entirely to correct typing slips for which he used the arrow keys and the delete key effectively. At the end I asked him when he would use the Spelling Checker. He told me that he would wait until he had got to the end of his story.

Godfrey's typing speed moved from 11 words per minute to 17 over the year covered by the 3 observations.

Teri (Standard 3-4)

Teri's diary entries are relatively few for the first year (23), but increased to 103 for 1987, and were usually up to 20 words long. In 1986 she referred to progress with a specific story, or who she was working with, but some comments are more reflective, e.g., "it is very exciting" [6.6.86] and "I enjoy writing on the computer because if you make a mistake you can go back on it and fix it up. But on paper you can't." [6.11.86]

Her diary comments for 1987 show more awareness of various aspects of the writing process such as her progress with a particular story; e.g., "I did about six or seven lines on the computer." [10.4.87]), the use of the dictionary (e.g., "Today I finished my story called The Hundred Dollar Note and started spell checking it." [2.4.87]), or help from peers ("Michael M. helped me get into my story and out of it." [30.4.87]. However, her entries are bland with no reference to her attitudes towards the use of the computer in 1987.

The computer log entries are confined to brief outlines of her writing activities (e.g., "typing on computer").

As revealed by the "Attitudes towards Writing" questionnaire, however, Teri changed many of her views about approaches or attitudes towards writing during the study. For example, at the beginning and end of the study she felt she was quite good at writing, but not so in between. At the beginning of 1986 she enjoyed writing stories most of all, but changed her view later in the study. However, she consistently stated that writing helped her to learn more and that she found other people's comments helpful when they read her writing. At no time was writing her favourite activity at school.

Throughout the study, she was unsure whether she was a good speller, but stated that she looked through her writing for spelling mistakes and used a dictionary. Apart from the end of 1986, she sometimes had trouble thinking of the right words. Generally she enjoyed looking over her writing trying to improve it and, by the end of the study, stated that she let other people make suggestions about her writing. On all occasions, she agreed that she was satisfied with her writing without making several drafts and changes.

The first evaluation panel who examined her writing stated that the February handwritten pieces were simple in content; although both the description, and the story, contained many ideas they were not developed, and there were several spelling errors. The letter was more carefully edited and reasonably accurate in layout, though the vocabulary was very simple. The November pieces also tended to be lists of barely connected ideas, especially the description which repeated lists of sports events 3 times. However, all pieces were more carefully edited with very few errors compared to the February handwritten pieces.

The handwritten pieces from the middle of 1987 continue the trend towards more accurate use of language, although the content of the pieces is still somewhat disjointed. Some of the sentences, particularly in the story, are more complex, and language use is generally accurate, particularly spelling and punctuation, except in the recipe (numerous superfluous commas) perhaps because of unfamiliarity with the format.

Teri was unsure both whether she enjoyed writing with the word processor and whether the word processor was improving her writing, but in the latter half of the study thought that her spelling was improving. Both at the start and finish of the study, however, she thought that everyone should learn to write with the word processor, though halfway through was more unsure. Teri only changed individual words or punctuation when she edited her drafts. She had mixed feelings about using the computer for writing, and did not use the computer for much revising or redrafting.

The word-processed pieces written in 1986 initially varied in quality, and while those produced later in the year have a more complex sentence structure they show little development in their ideas. All of her word-processed pieces are very brief (under 200-250 words). The last 3 pieces use language more accurately, though again the choice of words is simple and there is no attempt at paragraphing. The last piece has consistently wider spaces between each sentence.

The 1987 word-processed writing samples are usually well organised, though confined to strings of loosely related events none of which is developed. "The Little Purple Space Ship" describes an encounter with a tiny spaceship but Teri does not know what to do with her story once the men come out of the ship. Each piece uses simple and complex sentences, though with little variety in vocabulary. Language use is accurate, though spacing of full stops is a little awry.

The Little Purple Space Ship

It was a sunny day and I was having a walk in the garden when I saw a little purple and yellow thing in ^amonst the flowers . It had: blue , pink , green , and light light orange lights flashing on and off . I walked closer and closer over to the thing in the garden . I carefully lifted it up and looked at it . It was a little purple space ship . I took it in side and showed Mum , but she just took no notice of me and kept on doing the dishes . I took it outside and put it on the ground down by my feet . Suddenly the lights turned off and some little purple and some little green and yellow men about three inches high came out . They talked in a funny langauge that I couldn't under stand . I found out what they were saying . They were saying " hello ," . I said hello back to them and said good-bye . Then they went back into the space ship . The lights went back on and the space ship took off into the air .

During the study, Teri's writing moves from almost staccato-like pieces with many loosely related ideas and inaccuracies in language use to more controlled written work. However, although by mid-1987 her writing is better organised, there is little development of ideas and her choice of vocabulary is restricted to simple words, with a few exceptions. Some of her work, though, is almost free of errors, so her proofreading skills appear to have improved considerably. There is no discernible difference between her handwritten and word-processed pieces.

Teri was observed using the computer 3 times: 16 June and 17 November 1986 and 26 June 1987. When first observed, she had no problems starting a new piece and the computer appeared not to inhibit her flow of ideas. She had some trouble with the keyboard, typing "i" for "l", and hunted for the full-stop key. However, by the end of the session she had overcome both problems. For the second observation, she knew all the procedures including use of the spelling checker, and looked up words in the dictionary. She did not always use commands in the most economical order (e.g., she did not always delete in the most efficient way). A similar trend was observed 7 months later:

> Teri started the session by trying to boot with her data disk rather than with Fulltext. She appears to do quite a few actions . . . relying on trial and error. Teri still appears to be using techniques from the old version of Fulltext rather than taking full advantage of the newer version. For example, to correct a typing slip in a word she will delete all the characters . . . from the end of the word to the letter that needs changing. Then she retypes the rest of the word. A more economical method would be to use the arrow keys to position the cursor to delete and insert the minimum number of characters. It was also interesting to observe her reading through her text whilst holding down the right arrow so that the cursor skimmed through also, line by line.

Teri concentrated on composing rather than editing or presentation, though at the end of 1986 she was using blank lines to separate her title from the text and paragraphs were well spaced. Punctuation was inconsistent. By mid-1987 she still used various spaces around commas and full stops, and some sentences started on a new line while still part of the same paragraph.

Teri did not seem short of ideas during the observations, though it ". . . seemed as if there was no planning and the inspiration came from the first title that she thought of. Considerably more time was spent correcting errors than thinking of words to write." [26.7.87] According to the observer [17.11.86]:

> Teri's main problem was with spelling and she was clearly worried if the word did not look right. At one point she had difficulties with the word 'birthday'. She first tried 'bothday', deleted the whole word, tried 'borth' and deleted the word again, and then tried 'brothday'. At this she shrugged her shoulders and continued her story. A few minutes later she needed the spelling of the word 'invited' and instead of attempting to spell it she went to her books to look it up in her *Spell Write* dictionary. Having been successful with 'invited' she then looked up 'birthday' and went back to fix up that spelling in her text. Later, she used the computer dictionary to check the spelling of 'aren't'.

Her typing speed improved from about 4-5 words per minute to about 8 words per minute during the study. She always typed with 2 fingers of each hand, but with frequent pauses to check each word on the screen.

Michael (Standard 3-4)

In his 1986 diary, Michael made 24 brief entries. He enjoyed using the computer because he did not get sore hands and fingers from writing [e.g., 14.10.86]. In 1987, he made 89 entries, perhaps as a result of diary writing being made part of the class routine. Most comments refer to starting or continuing a particular story, although some refer to other computer activities (e.g., "Printed draft and good copies. I was on for half a period." [10.6.87]) or to the teacher reading his writing or discussing it with him.

Some references early on are made to the use of the computer dictionary (e.g., "I no [*sic*] how to work the dictinary [*sic*]." [27.2.87]) and, later, to the spelling checker, which he usually seemed to use with the help of others (e.g., "Simon helped me with spell checker." [5.8.87]). However, Michael rarely reflected on his feelings about the computer. His computer log entries rarely exceeded 1 word (e.g., "story").

Michael changed his views about writing in several ways during 1986 and 1987; for example, at the beginning of 1986 writing stories was his favourite activity at school, but not subsequently. He thought that he was quite good at writing when the study began and finished but not halfway through. He consistently agreed that he only did writing when he had to. He was initially unsure whether he was a good speller, but by the end of the study thought that he was not.

According to the first evaluation panel, the February 1986 handwritten pieces were, in general, lacking in flow and limited in their vocabulary, punctuation, and sentence structure. Although the choice of words in each piece is simple, some are incorrectly spelled, and the only type of punctuation used is the full stop. The November pieces are more accurate in their expression, apart from the story, but still poorly organised. The letter is slightly more focused and laid out a little better. However, all the November pieces have a greater variety of punctuation and fewer spelling mistakes.

The handwritten pieces in the middle of 1987, 8 months later, all show a higher degree of control over content, organisation, sentence structure, and language. Technically they are considerably more accurate, with appropriate punctuation and virtually no spelling mistakes. Although the choice of words is still very restricted, his sentences are occasionally more adventurous in their construction.

The "Writing with a Word Processor" questionnaire showed that Michael had very positive views. He claimed that writing was fun, that he liked making changes to his writing, and that it was getting better because he used the word processor. He also thought that his spelling was improving, that writing with the word processor was his favourite activity at school, and that everyone should learn to write with a word processor. He liked writing with a computer because he did not have to rub out mistakes, and he did not get sore hands.

The word-processed pieces in 1986, apart from increasing in length, showed few signs of development or planning. All contain strings of undeveloped ideas about the topic in the respective titles, have very simple vocabulary and sentence structure, and require considerable editing, although the 2 final copies are punctuated more appropriately. During 1987 another 4 pieces of computer-produced writing were obtained; they are generally simple and not very well organised. "My Day in the Truck", for example, a draft, is again a short personal narrative but includes some more complex sentences, and is correctly punctuated.

My Day in the Truck

One day Dad and I went in the truck to cart a farmer's lambs. We woke up at 8:00 o'clock. We had the lambs on at half past eight. We carried them to Timaru to the freezing works. Dad moaned, "We will be in Timaru at 11:00 o'clock, we will be home at 2:00 o'clock," On the road to Timaru with a load of sheep. It was 11:00 o'clock we were just about there. About half an hour we were at the freezing works. We had about three hundred lambs on the back. We unloaded the lambs which took us about forty five minties. On the way back home we seen lots more trucks and cars on the way back home we reached home at 2:01. I had a good trip to Timaru. After that we went to load another truck driver.

There are hardly any differences between Michael's handwritten pieces and his word-processed writing, although in the early stages of the study, perhaps due to the effort needed to master the use of the computer, some of the word-processed pieces appear to require considerably more editing than the handwritten samples. Over the 18 months, his writing has improved to some extent: sentence variety is more apparent, ideas are more closely related to the topics and, perhaps most obvious of all, his mastery of the conventions of language use has increased with fewer spelling and punctuation errors. His vocabulary, however, is still very simple and nearly all the pieces contain personal accounts of events covering a short period of time. Sentence syntax, despite more complex sentences, is still relatively simple.

Three formal observations of Michael's computer writing were made: on 24 June and 4 November in 1986, and 24 June 1987. Apart from distractions caused by the printer he was on-task, requested no assistance, and was generally confident in using word-processing procedures, particularly after the first observation. According to the observer, "though he did not always use the most efficient methods available to achieve the task, he succeeded in all that he attempted to do, even if it meant careful reading of the prompts on the screen." Other comments deserve highlighting:

> While composing made a particular effort to correct all spelling and typing errors as he typed. This was done by back-spacing and inserting the required characters as he typed a particular phrase. The two or three surplus characters that remained were removed by using the right arrow and the delete key. The editing of his draft copy required him to cut out whole words and to insert others, all of which Michael was able to do efficiently.
>
> Though the task of writing seems painfully slow, it is also apparent that he does take a pride in the final appearance of his work and satisfaction in correct spelling and punctuation.

Michael's speed of writing was very slow, perhaps 6 words per minute, due to spelling errors being made and corrected as he wrote until they looked "right".

Sharon (Standard 4 - Form 1)

Sharon's diary comments, particularly for 1986 (143 entries), offer comprehensive information about her computer use; early on, she frequently assessed her knowledge, for example "I still don't understand how to delete words very well" and "finding it easier than I thought it would be". She was alert to her own composing process; e.g., "I felt that every time I thought of an idea, I'd forget it before putting it on the screen", "I think the computer dictionary helps me to retain words", and "I find the spelling check useful for proofreading what I have done so far, instead of leaving it till the end" (there are several references to the use of the spelling checker). She also helped other pupils and, over all, found writing with the word processor very enjoyable. Early in the third term she appeared bored with the computer, e.g., "I'm sick and tired of having to go through everything again", and "I think 5 periods a week is too much".

For 1987, there are 47 diary entries. Generally Sharon's comments are much briefer, e.g., "I started . . . ", "I carried on with . . . ", or "Finished . . . ", and, with odd exceptions (e.g., "I really wanted to do a long

story, but we've only got two more periods to finish the whole thing." [11.2.87]), considerably less reflective about her computer experiences than in 1986.

Some of her attitudes towards writing changed during the study. Both at the beginning and end she agreed that she could write for a long time without getting bored, that she revised extensively, and that she talked with her friends about her writing, but not so midway. In 1986 she agreed that writing helped her to learn more, but was unsure by the end of the study. She had no doubts about being a good speller until the final "What Do You Think About Writing" questionnaire, when she was less certain about her spelling ability. Sharon never stated that writing was her favourite school activity, although she seemed to enjoy it and wrote very well. By the end of the study she was unsure whether she was a good writer, and did not enjoy discussing her writing with her teacher, unlike in 1986.

Comments on Sharon's writing from the first evaluation panel reflected her excellent control of language, which was considered "very impressive". Her handwritten pieces in February 1986, at the beginning of standard 4, were regarded as well organised, stylistically appropriate, and accurate in language usage. All, however, are a single paragraph in length. Her November 1986 samples contained 755 words altogether, compared with 265 for the earlier samples and, perhaps partly as a reflection of greater length, contained more complex sentences. However, they were also very well organised and "mature", according to the panel, with devices such as metaphors used appropriately and "adult" vocabulary. She appears to enjoy playing with words and experimenting with styles, showing a well developed awareness of the uses of written language. "My Wonderland", for example, describes Sharon's home where she lives with her grandparents, using complex sentences, mature vocabulary (e.g., "supervises", "twittering", "certain privileges"), and devices such as metaphors (e.g., "my home is a definite wonderland").

The handwritten pieces from July 1987 are technically accurate, with correct punctuation, spelling, and sentence structure but the ideas are not developed. The story, "The Phantom Scarlet Strawberry", is inventive but does not develop the topic despite a promising beginning "One day in the ice age, a medieval time machine landed on the ice." However, it is in paragraphs, and some of the sentences are complex. The language is full of cliches ("this was the last straw", "the end of the world", "the mists of time", "landing . . . in deep water"). It is possible that the story is intended as a brief parody of the science fiction story.

Sharon also changed some of her views about writing with a word processor during the study. Initially she was unsure whether the computer helped her spelling or writing to improve, but agreed subsequently that it did. However, by the end of 1986 she no longer considered writing with the word processor to be her favourite activity, as she had when the study began, and by the end was unsure. She was more enthusiastic about everyone learning to write with a word processor earlier in the study than she was later.

As her diary indicates, she revised less towards the end of 1986, and no longer enjoyed adding or removing words from her stories with the word processor. By halfway through and at the end of the study she had no special preference for writing with a word processor, and agreed that she would like to do some writing with a word processor and some with pen(cil) and paper. Like many other pupils, she liked the word processor because of the neat printing, and the fact that changes were not obvious.

Her word-processed pieces share the same qualities as her handwritten samples, with clear expression, occasional humour, and inventive vocabulary, particularly in the story "Microfluff on the Moon" which experimented with clever devices and a facetious style. The final version at 900 words is her longest piece of writing; the extract below has been edited. Microfluff is a cat who becomes ambitious to go to the moon as an "astropuss", but the adventure never happens. Sharon focuses on the cat's changing into an astropuss, and the reactions of her stuffed-toy friends, until she becomes "an ordinary pussy-cat again". The writer is adept at taking everyday objects and turning them into something special, but the potential of the story (a trip to the moon) is never achieved. However, it is well organised, keeps the reader's interest with astute observations (some asides in parentheses), sophisticated vocabulary, and a facetious, humorous style, and shows a willingness to experiment with language (e.g., "thinkingfur", "Pussy-yodelling").

Microfluff on the Moon

Microfluff.

Microfluff was a pussy-cat. She lived in a typical New Zealand house-hold. Like every other pussy-cat in the neighbourhood, she was pampered every day by her master. In this case it was Henry. There were two other members in the family. They were two children. The elder was named after her great-great-grandma. . . .

Although Microfluff was just an ordinary cat, she had more in her brains than apple-jelly you know! She could at least be regarded to have raspberry jam! All of a sudden, she remembered where she had put Astro! In the basement of course! When she was playing hide-and-go-seek-the-mouse, she had taken Astro along for the ride. Abandoning the chair, Microfluff ran down to the basement and found Astro among the coal and cinders. She was so excited, on finding Astro, she could hardly find the words to tell Astro the good news.

"Astro, I've decided to become an astro-puss!" Silence.
"Astro I know you have a sore throat, but you just have to answer me! You've had that sore throat for as long as I can remember! I'm beginning to think you're having me on! " explained the exasperated Microfluff. She was utterly angry. She was so angry, she BLEW HER TOP! That was when the changeover started happening. Gradually her ears began growing slightly inward. This was probably to enable her head to fit inside the space-helmet. Next her front legs grew, looking like arms. She also realised that she could stand up on her back legs a lot easier. She did not really notice this happening. I suppose she was too involved in preparing for the trip. . .

The Actual Changeover.

She said she felt as if she was floating on air. Astro knew what had happened and felt very sad. For he knew Microfluff was ready to face the whole wide world of Astropuss life. Microfluff started noticing that she was changing too and she wondered what was happening because with all the things that had happened, she had forgotten all about what her ambition was. She decided she would not go to the moon because her friends would miss her too much. That fixed that problem, but now she had to get back to her normal self. She asked Astro to make her mad so this is what he said to make her mad, "Microfluff Smith you are a two-faced double-crossing midget!"

Microfluff blew her top and became an ordinary pussy-cat again.

The 2 other word-processed pieces from the last term of 1986, apart from requiring minimal editing, are also clearly expressed and organised, with varied sentence structure. The word-processed pieces from 1987 (around 300 words each) tend to be shorter than those from 1986 (450 words), one being a chatty description of a shoelace's life story, using lively vocabulary (e.g., "a hulking great SHOELACE!") and a wealth of detai's (e.g., the shoelace comes from Stringvania). However, the account is a single paragraph and does not flow smoothly. Another follows a clear storyline - the advent of a new headmaster with odd ideas - and ends with a reflection on the fate of strange headmasters.

She was clearly a very competent writer when the study began, and this pupil appears to have progressed considerably in the first year as her later experiments with language are very well handled for a pupil of her age. Apart from sustaining her imaginative ideas through even longer pieces of writing, it is difficult to see how she could have written better within the constraints of the forms she was using.

However, in the second year up to July 1987, apart from occasional flashes of inventiveness, there is little evidence of Sharon's progressing as a writer and further fulfilling the clear promise as a creative thinker which she showed in 1986. Perhaps she had reached a plateau in her development as a writer. Perhaps the expectations of her form 1 teachers were more constrained than those of her standard 4 teacher. Also, given the skill with which Sharon wrote anyway, she may have required different challenges from those set by her 1987 teachers, who appeared to be unaware of the potential uses of written language and its development in talented individuals. The word-processed stories and descriptions from the first half of 1987 fail to develop often brilliantly conceived details; it is as if she was told to keep to a page in length, and no more, and the ideas cannot cope with the limitations of the imposed format.

Observations of Sharon using the computer were made on 15 July and 4 November 1986 and 29 June 1987. She was always very confident following the procedures, "even to the extent of checking with the spelling checker while midway through composing her story" [15.7.86]. In 1986 the ideas flowed easily, and she received "evident satisfaction from the composing process" [4.11.87]; "while composing she rarely stopped to read more than the previous sentence before continuing with the next" [15.7.86]. She was confident with the keyboard, using 3 fingers of each hand.

During the observation in 1987, Sharon wrote a letter at first, then started a story. However,

> Sharon was clearly not motivated by the idea of writing the letter. She had to think about each sentence and preferred to get the job over as quickly as possible. She had a different approach to the story but did not have enough time to really get into the swing of writing it.
>
> Asked about her opinion on the new version of Fulltext, Sharon said that she liked the simpler editing methods and the different varieties of character that could be used on the screen. Being rather surprised at her unimaginative letter compared to her story I asked her how she would grade each one out of ten. She said that she would rate her story at seven-and-a-half but the letter at only five. It was interesting to find that the task of writing a letter to a friend that had so inspired Eric in the same class, had little motivation for Sharon.

This time her typing speed was estimated at about 15 words per minute; in 1986 [15.7.86] her speed was about 18 words per minute.

Sharon was possibly the most innovative writer in the study and made very few spelling errors. At the end of 1986, the observer noted "evident satisfaction when her invented spellings for one character's direct speech were identified by the spelling checker", and in estimating her speed of typing (not given) stated:

> It was difficult to estimate her speed since she was trying to compose a piece of direct speech which took the form of interviewing such characters as Mrs Blouse and Master Kilt. Each character spoke in a strange accent which required a certain amount of experimentation in spelling: i.e., 'da sabe person' for 'the same person'.

Sharon played with words in ways which none of the other writers in the study even approached, inventing her own and spelling very competently.

Sean (Standard 4 - Form 1)

As with Thomas, Sean's 160-odd diary comments in 1986 are mainly brief statements ("Started new story on the computer" [28.4.86], "Finished story called 'The Address' " [30.5.86]), sometimes referring to the spelling checker ("Used spell-check and for the start I had 20 suspect words" [26.9.86]), though occasionally they are more analytical (e.g., "Deleting is better than rubbing out" [5.5.86] and "I must read the screen as I type" [19.9.86]). His 1987 diary entries follow the same format as Thomas's, perhaps at the teacher's instigation, and are very brief.

The "Attitudes towards Writing" questionnaire showed that, except halfway through the study, he did not discuss his writing with his friends. He claimed that he consistently looked through his writing for spelling mistakes and ways to improve it. He often decorated headings or drew illustrations. At no time did he think

that writing was his favourite school activity. His responses about punctuation are interesting: at the beginning of the study he disagreed with the statement "I don't like having to worry about where to put all the commas and fullstops in writing", was unsure about it at the end of 1986, and agreed with it by mid-1987. On all 3 occasions he also agreed that writing helped him to learn more.

The February 1986 handwritten pieces of this pupil were considered by the marking panel to be simple, with undeveloped ideas, but accurate in language usage and sentence structure. All 3 pieces are almost flawless technically - well punctuated and with accurate spelling apart from one or two lapses - though lacking in development. The November samples are more extensive in content, not surprisingly since they total 710 words compared with the 170 words of the February items. They are more complex in sentence structure and vocabulary, and all pieces, as were the first set from February, have accurate punctuation and spelling.

The handwritten pieces from the end of the study (July 1987) are all poorly structured with single paragraphs and dull content. None of these pieces seems to have been written with particular care, as the style of handwriting/printing changes frequently and words are crossed out or letters written over, and the content is poorly focused. Sean's control over language conventions appears to have taken a backward slide, and his ideas are not developed.

By the end of the first year Sean enjoyed using the word processor, helped others, thought it was fun, that it made writing a lot easier, that it was helping his spelling and that his writing was improving, although he was unsure whether it was his favourite school activity. By mid-1987 he still held the same views but was less sure about whether the word processor made writing a lot easier or whether it was helping his spelling. He consistently liked both word-processed and longhand writing and, except at the start of the study, made additions and deletions, including whole sentences, to his text. He liked the word processor because "it is easier to delete parts and add them in another place. You can check your spelling with the fullspell. You can enlarge, underline, make it stand out . . .".

His word-processed pieces are disjointed initially, with very little planning evident, and occasional language errors. The first 2 pieces, both drafts, are poorly structured and edited. The vocabulary is simple. The last 2 pieces from 1986 are considerably longer. One consists of a series of events without real development. Although it is divided into paragraphs they are not used appropriately, and the choice of words is simple though the sentences are more complex in structure. Generally, language usage is accurate.

The word-processed pieces from 1987 are in a similar vein. Most are single, short paragraphs though there is a lengthy piece of writing at 600 words. The final, edited piece of writing from the computer, "Escaping" is also fairly long at 500 words but is here shortened to 250. Although the story is derivative, some of the ideas are more complex than in earlier pieces, and like the later handwritten items are related in long run-on sentences with lots of ideas tied together in a breathless sequence (e.g., a description of knocking out a commander and making good an escape). A tally of deaths is given towards the end of the story; yet another list! Little attention appears to have been paid to correct language usage in parts.

Escaping : :

During the 3rd WORLD WAR, a platoon of solders were taken by surprise. And was taken to Japanese fort were we where kept prisoners. In one week ten more platoons were brought in to the fort and by now we were getting a bit feed up with the work that we had to do for the solders. One night a commander of a platoon had an idea, someone would get a guard to come to him and someone knocks him out and another person will get the keys and unlock the door, the person with the keys would also unlock the prison doors.

The commander that thought of the idea decided to get the guard to come over to where we were, he came over running like mad to see what was the matter, when arrived, I tied his shoes laces

together and when the general came over he fell flat on his face. When the commander climbed up, he untied his shoes laces and the commander who thought of the idea knocked him out cold and I slipped the gun out of the pocket without the general knowing, that I had did it and I pointed the gun at the general, he tried to get his gun out but I saw him and shot him and grabbed his gun and shot the alert button, I raced out the prison doors where I just made it thought before the Japanese solders started to shoot at the twelve platoons. . . .

In general, although the quantity and quality of sentences appeared to improve, as did the presentation of his written work, there was little evidence of expansion of ideas or vocabulary during the first year of the study. In the second year, organisation appears to have worsened as initial concepts or ideas are not developed. There is no evidence of progress, although the later word-processed pieces, from the middle of 1987, appear to use more complex vocabulary. There is no evidence of concerted editing with the word processor and basic errors which did not occur in 1986 are more prevalent in 1987.

The formal observations of Sean using the computer were made on 17 June and 18 November 1986, and 25 June 1987. Sean was very confident using the word-processing procedures and had few difficulties:

> Sean has clearly mastered the rules of punctuation and layout, and though he lacks imaginative ideas for his writing, he is able to maintain a flow of words that makes up his story with ease. Certainly he has established a successful strategy for producing quite lengthy pieces of writing.

However, "he did not read back his story at any stage". A similar observation was made at the end of 1986:

> Sean seemed to have plenty of ideas. His story was full of action so he was kept busy, seemingly thinking faster than his typing could cope with.
>
> Sean typed with 2 fingers of each hand and about 12 words a minute.

Thomas (Standard 4 - Form 1)

Thomas's diary comments (over 140 entries for 1986) briefly outline specific activities such as starting a story (e.g., "Started a story called Our Nobby." [24.4.86]) and correcting or printing out (e.g., "Corrected rest of Mad Case Victim and printed a copy." [20.6.86]; "I had problems with the printer. It kept printing on the same line." [6.8.86]), with the occasional reflective comment such as "Tried to type without looking but too hard" [29.7.86] and "I enjoyed using the computer today" [14.4.86]. Regular 1987 diary entries were made using a different format (a single line with the date, a comment, and time starting and finishing on the computer) so the style was more truncated (e.g., "continued story" or "printed draft copy").

Some of his attitudes towards writing changed during the study. For example, early on he found it easy to write the amount the teacher wanted, but not so by the end of the first year. In the latter half of the study he let other people read his writing to make suggestions, and liked helping his friends to improve their writing, though not so earlier. At no time did he consider that writing was his favourite school activity. To begin with he was unsure whether writing helped him to learn more, but he was more positive later on.

While Thomas consistently claimed to check his writing for spelling mistakes and to use a dictionary, he was uncertain whether he was a good speller. By the end of the study, he claimed to enjoy revising his writing, though had been unsure earlier.

According to the first marking panel, Thomas's February 1986 handwritten pieces have simple content but reasonably accurate sentence structure and language usage. The November pieces are more complex in content, sentence structure, and vocabulary and, apart from a small number of mistakes, accurate in language usage. All are considerably longer than the first set of handwritten pieces (a total of 770 words compared with 235).

The pieces written at the end of the study in July 1987 are of a similar length to those from the end of November 1986 but paragraphing is erratic. With a few exceptions, however, most of the sentences are simple in structure, spelling is accurate apart with some exceptions, and there is an attempt at paragraphing.

Thomas enjoyed using the word processor, and liked making changes to his writing. However, while he thought halfway through the study that his writing was improving because he used the word processor, he had been more uncertain to start with and finished up uncertain. He was also uncertain whether his spelling was improving, though he had been more confident when the study began. At the end of the study he thought that everyone should learn to write with a word processor. Generally he preferred to do all his writing on the word processor.

The first computer piece, a draft, is brief, with simple sentences recounting an experience, which is not developed, with a sidecar. The writer seems to be learning how to get his spacing right, and there are several strange characters (e.g., unnecessary speech marks) on the page. Spelling is reasonably accurate.

Another 1986 piece is the 550-word "My Invention of the Diack Car" (edited to 285 words). Thomas's control, at least over his content, appears to be improving, as the text consistently focuses on the same theme throughout. However, although the events leading up to the building of a super go-cart and its racing debut are recounted in an orderly sequence, the adventure does not flow smoothly, perhaps because of the repetitive nature of the simple sentences and the lack of editing. Thomas appears to be more confident in using the computer for other purposes, too, since the story also contains an illustration of a car (not included here) composed on screen using various keyboard symbols. However, his spacing (e.g., full stops) is still idiosyncratic. Language usage is reasonably accurate with occasional misspellings. The vocabulary is fairly simple except for terms describing the go-cart.

My Invention of the Diack Car

It was a cold Winters morning a day for out in the shed .
Dad asked me what I wanted to build . I replied a motorised gocart . Dad said it was a great thing to build . At once we went and found two pairs of wheels and then two axles one with a pulley on it . Dad and I found the right type of metal and started building .There was one thing missing . Dad did not know what but I did . I shouted out"The welder" ....

It only needed the tin out-side which was the main part of it .
Dad went and hooked the trailer on to the car .
Both of us went to Benney's Engineering to get some sheets of tin. Dad took half an hour because he was talking .
We arrived back to do some work ,but it was lunch-time . Eating my lunch , the phone rang . It was Nigel . He wanted to help with the gocart . Dad said that we could get it built quicker ...

I waved the purple and pink spotted hanky . Bert won the start . He went sky high when he did a jump . There were two laps . The first lap Andrew was way behind but on the second lap Andrew caught up behind . Bert pushed hiperthrust button and zooommed off , but that did not stop Andrew from catching up because he pushed lightning streek . He caught up again . They finished the race equal . It was amazing .I drove Bert back home to Sarah's house . I let him out of the car. Bert barked three times .I guess that was to say thank-you . I put the go-cart in reverse and spun my wheels out of Direen's drive and started heading for home .

The word-processed pieces from 1987 are lively and show some risk taking with style, layout (diary format), and accents though with little attention to editing as there are numerous spelling and syntactical

mistakes. "The Day In The Life Of A Flea" (a draft) recounts in an imaginative way a flea's life on a dog and some other animals. The content and style are interesting from the beginning ("I awoke in the morning with a bump on my head because a big furry creature that was supposed to be my bed sat on top of my poor little head."), with several lively metaphors and similes. The piece has 3 paragraphs, but they do not match the content of the story particularly well, while spelling and punctuation in parts require attention. However, like nearly all of his written work a reasonable amount of editing is required to improve the quality of the presentation.

Over all, during 1986, while the content of his written work has expanded, there are still many loosely connected ideas in each piece of writing and little evidence of growth in other areas. According to the panellists examining the 1987 samples, the handwritten pieces, which came later in the year than the word-processed ones, are less exciting in style and content but more "correct" than those written on the word processor. Those done on the word processor are more imaginative and show more risk taking, perhaps because some of them are drafts before any teacher intervention has occurred. It appears that Thomas's language usage has developed during the study, both in vocabulary and sentence structure, but his organisational skills show less evidence of improvement, and editing, although better than when the study began, still needs a lot of attention.

Three formal observations of Thomas using the computer were made on 23 July and 4 November 1986 and 23 June 1987. Mostly he appeared confident in word-processing procedures, though he encountered some difficulties with the new Fulltext [23.6.87]:

> My impression was that Thomas wanted to show how well he could use the new Fulltext and so tried to use quite a few of its features. Most of them he managed with ease though he did need to read the prompts on the screen when the result of his key pressing was not quite what he expected. It was . . . as a result of using the spelling checker that . . . [he had] . . . a later problem when he came to save his story. Having changed the disk prefix to 'Full spell', he needed help to change the prefix back to that of his personal disk. However, he was successful in looking up the spelling of 'care' which he incorporated into his story as 'careful'.

On an earlier occasion [4.11.86] the observer had noted:

> When he began his new story he got as far as the title "***GUY FORKS NIGHT", hesitated, and then changed the title to "***MY INVENTION OF THE DIACK MOBIL". He then searched the computer dictionary for the word 'mobile' by making it search for 'MOBEL', then 'MOB?', and finally 'MOB?LE', all unsuccessful because he failed to recognise the word when it appeared in the list on the screen. His search technique was in fact faultless. He then gave up and substituted the word 'CAR' for 'MOBIL' in his title. I then asked him which word he had been looking for and he pronounced the word correctly and confirmed that he failed to recognise it from the word lists. This frustration in failing to find the word in the dictionary lead [*sic*] later on to spelling by trial and error. One example was his attempt to spell 'idea'. He first tried 'idaa', then 'idii', and then without consulting the dictionary, changed the word to 'thing'. Presumably it had been the spelling of 'Fawkes' that had been sufficiently difficult to prevent him starting his first choice of story, but apart from the obvious spelling difficulties, he did seem to enjoy the writing process once he got into the story, particularly when it was about himself. He saved his story under the catalog name 'THE DIACK INVENTION'.

His typing speed was slow, perhaps about 7 words per minute:

As much time was spent changing characters as composing new text. As a consequence he had produced a spelling-error-free and grammatically correct piece of writing by the end of the lesson, and he seemed confident that it was well written. He used 2 hands on the keyboard but only 1 finger from each hand.

John (Form 2-3)

John made 41 entries in his 1986 computer log. He describes the stages he was at with different writing activities, e.g., "I finished writing a story called a Party then started checking." [28.5.86], "Correcting my final

copy of my story" [21.4.86], "Started new story." [29.4.86]. His computer diary includes 23 comments about the computer, mainly about his level of enjoyment, e.g., "I enjoyed working on the computor [*sic*] today because I didn't have to work to [*sic*] hard." [24.9.86]. Some of the diary entries repeat statements made in the computer log. His 1987 computer log/diary was not made available.

John's responses to the "Attitudes towards Writing" questionnaire show him becoming more disenchanted with writing and collaboration with others over the first year. Early in 1986, he claimed that he wrote many stories, shared ideas with friends, had writing conferences with his teacher, and preferred not to change his writing. However, subsequently he disagreed with all of these views. By the end of the study he agreed that writing helped him to learn more, he let others make suggestions, and he changed parts of his writing after the first draft. He consistently claimed to check his writing for spelling mistakes and to use the dictionary, and that it was helpful for others to read his writing to make responses to it but writing was never his favourite school activity. However, while he initially stated that he enjoyed revising, he was more uncertain later on.

The handwritten letters are correctly set out, apart from minor details, are about 100 words long, and generally contain a number of spelling and punctuation errors, and run-on sentences. However, the style in 1 letter is sometimes chatty and engages the reader. The 2 descriptions are poorly organised, though with varied sentence structure and vocabulary appropriate to the topic. "My Pet" describes the family dog and some of its habits in 2 paragraphs, although the first takes up nearly all the words. Two asides to the reader are marked by parentheses, and the sentences are varied in structure with vocabulary appropriate to the topic. Apart from a couple of spelling mistakes the spelling is sound, and punctuation is accurate apart from a missing apostrophe and a misplaced one.

Both stories are from 1986 and are rambling, lacking in sound organisation, and lively vocabulary. The language is simple and there are several mechanical errors. According to the first marking panel, the handwritten pieces composed in February were well developed, with an appropriate sense of audience, vocabulary, and sentence structure. However, revision was felt to be necessary, and there was an absence of paragraphing. The November samples, with simple language, were considered less well developed, lacked the author's voice, and required a great deal of editing. Little change is apparent between these and the 2 pieces from mid-1987.

Similarly, when responding to the word-processing questionnaire, John's initially positive views (e.g., he stated that he enjoyed discussing his writing with friends after using the word processor, that writing with the word processor was his favourite school activity, and that he enjoyed adding and removing words from his stories) became more negative. Why his initial enthusiasm gave way to indifference and boredom is not clear.

To start with, he preferred doing all his writing on the word processor, but later on had no particular preference for either kind of writing. Despite his growing disenchantment, John consistently thought the word processor was helping his spelling, that his writing was improving, and that everyone should learn to write using a word processor. He also claimed, at the end of the study, that he enjoyed writing more than he used to because of the word processor, and that it made writing easier.

The word-processed writing samples exhibited similar features: some were well developed, with adequate vocabulary, sentence structure, and language usage, while others needed considerable revision. The 2 final copies are sounder in their mechanics though commas are sometimes used instead of full stops. "Spooky Terror" (July 1986) is his longest piece of word-processed writing (and longest paragraph) at 300 words and is a fairly hackneyed attempt to tell a horror story about 2 boys who experience some frightening events in a haunted house while retrieving a ball. There is little attempt at developing an evocative mood, although much of the vocabulary is appropriate. While the sentence structure is varied, several are run-ons and some of the punctuation needs revision. The spelling is accurate.

There are 3 pieces of word-processed writing from 1987, but they lack clear development of topics and appropriate paragraphing. Although the sentences require editing to improve their structure, language use

is generally accurate. However, the final piece from 1987, "The Old Bomb" (240 words), recounts the restoration to working order of an old car using careful details (e.g., "We took the whole head off the engine and cleaned and freed the valves."). There is a greater sense of reality and personal involvement about this piece than in most of John's other efforts, and the language used (apart from 1 or 2 sentences) is more accurate, with some lively vocabulary (e.g., "surge forward", "jolted", "whirring") and several paragraphs for different phases of the restoration.

The Old Bomb

It all began one boring afternoon when my cousins and I had nothing to do so we decided to go and fix up the old yellow bomb of a car nick-named the yellow terror .

Well it took us all day and all we did was dirty ,it was covered in rust and full of cobwebs and other muck like that .Overthe next three days we cleaned out the hole of the inside and polished the outside.
The next job was to get the engine going that proved to be a less than easy task because the engine had become seized from sutting in the shed for so long. We took the whole head off the engine and cleaned and freed the valves . It took a long time but at last the engine the engine was in going order at last so we put the engine back together and attempted to get the yellow terror moving. Dad went and got the tractor and a chain to tow the car out the drive .Finally we were ready to go I jumped up in the tractor and slowly pulled away.The chain pulled tight and eventualy the car began to surge forward . finally we were underway. We started to gain speed and when we got to a certain speed Dad let the clutch out . the car jerked and jolted and their was a wirring noise . Then all at once the car started at first it was coughing and choking and their was clouds of smoke and dust but it soon settled

Over all, John's writing was considered technically sound though few improvements were noted over the first year of the study, with possibly a regression in the development of topics and use of vocabulary. The drafts were considered to require considerable editing in order to remove superfluous writing and to encourage focus upon the topic. The pieces from the second year show an improved style and greater mechanical accuracy, particularly towards the end of the study, and better paragraphing, especially when John felt involved with the topic.

John was observed using the computer 3 times: 16 July and 3 November 1986, and 3 July 1987. He could have used the computer more effectively. For example, at first he -

> was confident in the basic techniques but gave . . . the impression that his approach to editing was very much 'trial and error', in a cautious way. For example, he deleted four words in two attempts of two instead of using the same keys once. When inserting he would frequently add an extra space, which would then have to be deleted again. He got the results he wanted by patiently working away until he was satisfied, though . . . it seemed that he did not get more efficient at it during the session. . . . [as] he was concentrating on getting the job done.

Halfway through the study John was "Very competent and workmanlike" but by the end still failed to maximise the computer's potential:

> . . . his approach was surprisingly inefficient. For example, while reading through and making corrections he demonstrated that he could delete and insert characters selectively, and yet while composing he would delete backwards a couple of words at a time in order to correct a typing slip, and then retype the words that had been correct.

John also verbalised while writing. He "maintained a verbal commentary on what he was doing, not inhibited in the least . . . referring to each key by the job it would perform". He also talked to himself during the last observation, e.g., "I'll fix that later" and read some paragraphs aloud to himself.

His typing speed was about 8-10 words per minute at the end of 1986, and increased slightly to about 11 per minute when the study ended.

Laura (Form 2-3)

Laura maintained a computer log (58 entries for 1986) with factual accounts of specific activities, e.g., "corrected . . .", "carried on . . .", "finished . . .". Her computer diary (34 entries), contains longer, more reflective comments either showing her general satisfaction (e.g., "I enjoyed using the computer today. It is really easy now because I know what I'm doing and don't need much help now." [23.9.86]) or recounting a specific activity (e.g., "I like putting stars or lines under my Title." [30.4.86]). Occasionally she mentions that the computer was boring, or discusses learning a new technique, e.g., Panasonic Defines. There are some references to correcting her writing, e.g., "And corrected some of my draft copy . . ." [28.10.86].

During 1987 Laura made entries in her computer log (43) and diary (27) using opposite ends of her notebook, following a similar pattern to 1986, e.g., with occasional comments about different aspects such as a visit by the research team to the school (e.g., "these people to do with the computer study wanted to see all the class at work. So I started another assignment . . ." [14.4.87]) or learning to use the new version of the word-processing program Fulltext (e.g., "The new way is quicker but I don't know what I'm doing half the time." [1.5.87]).

Some of her attitudes towards writing changed. At the beginning of the study she ran out of ideas when writing a story and found it hard to write as much as her teacher wanted, but had no problems with these aspects by the end of the study. She claimed to check for spelling mistakes throughout the study, though was less sure halfway through, and to change parts of her writing after the first draft. However, Laura was more consistent with other views. Writing was never her favourite activity at school, she did not appear to like others reading her writing to make suggestions on it, nor herself like looking over her writing to make changes, and she felt that she was not a good speller.

All of Laura's letters, including her last handwritten one from July 1987, are single-paragraph descriptions, from 150 to 200 words in length, of school or holiday activities and range across a variety of topics. The setting out is accurate, and concluding remarks are appropriate to the audience which, in each case, is a close friend. The vocabulary is simple, mostly words of 1 or 2 syllables, and there are some language inaccuracies such as run-on sentences and occasional spelling errors (e.g., "diffently" for definitely). Sentences are also simple in construction, although some variety is provided in the last letter from 1986 which uses several parenthetical asides as explanations of comments made in the letter. All are written in a lively, friendly tone.

The descriptive pieces vary in length from 100 words to 190 words. They are usually single paragraphs and attempt to use vivid language. The final one uses more complex and varied sentences, and the vocabulary appears to have been chosen carefully. This piece is more accurately expressed with few spelling mistakes. The 2 stories use simple vocabulary and sentences and require considerable editing to improve spelling and sentence structure. There seems to have been some improvement by mid-1987, however, as the letter and description include more interesting content and have fewer errors; the writing seems to be a little more sharply focused.

When the study started, Laura thought that writing was fun on the word processor, but was less certain subsequently. Her views about whether the word processor made writing easier also varied and she did not think that everyone should learn to write with a word processor. However, throughout the study she considered her writing was improving because she used a word processor and, by the end of the study,

thought that the word processor was helping her spelling (she had been less sure in 1986). She had no preference for either word-processed or pen(cil)-and-paper writing at any time.

At the beginning of the year, she enjoyed adding and removing v ords from her stories with the word processor but later on was less keen. Throughout the study Laura claimed that, on the last piece of writing before completing the questionnaire, she made a few changes to mechanical features (spelling, punctuation, and vocabulary) but did not make larger changes. No overall, developmental trends were noted during the first year except for a slight increase in length in her last piece of writing.

Her word-processed pieces from 1986, whether drafts or final copies, had similar features to the handwritten pieces. Errors recur through all of them, and each piece appears to need considerable revision and rewriting. "The Spooked House" (July 1986) is a final copy of about 200 words. Two girls going for a walk venture into a strange house and one of them disappears. However, little tension is evident as most of the story describes getting into the house rather than what happens inside it. Considerable editing is required to improve the use of language. The final piece is a very bland account of a series of uneventful experiences, with loosely constructed sentences, mechanical inaccuracies, and an abrupt ending.

The Spooked House

It all started on the way home from school Angela and I were walking down Stewart Street, the day before that we had been pick for a softball team and Angela had asked our teacher Mr Grant if we could have one of the softballs to take home to practise Mr Grant said yes. We were now walking home throwing the softball. Angela threw the softball too hard. It went through a broken window and into an old house. "Oh no", I said "what will we do now".
"How do I know", Angela said,"I surpose will have to go in".
"Oh just great that house is mecnt to be haunted no one has been in it for years", I said.
Angela started walking towards the house."Well are you coming or not", she said. About to minutes later we were in the house. We looked around there were some stairs leading up and a sheet at the top. The softball was at the bottom of the stairs I pick it up and said "Lets get out of here". But Angela was already half way up the stairs I called out"Were are you going".
"Up the stairs", Angela said.
"Well see ya", I said. Angela disappeared behind the sheet and that was the last I ever saw of her. I've always wondered what happened to her but I'll never go back in that house to find out.

In the second year there were 3 more pieces of word-processed writing. " The End of the Bed" (draft), from February, is about 200 words long. Again it is a single paragraph with some run-on sentences, and requires considerable editing, but the account of mistaking a nightgown for a strange figure on the bed is related through carefully chosen words and a building up of tension, considerably more successfully than with the earlier piece, "The Spooked House". Another piece uses paragraphs well, perhaps aided by the teacher's plan. However, there is repetition and awkward sentences, with some inappropriate choices of words and spelling errors. The longest piece of all (about 1000 words) is from June 1987. It describes an accident after a romantic evening with her boyfriend, and there are fewer run-on sentences, and some improvement in paragraphing despite the length of some paragraphs. Presentation has been varied, too, with the use of capitals and italics as well as plain text, but her problems with spelling, punctuation, and sentence structure remain.

According to the marking panel for the 1987 writing samples, Laura's paragraphing has improved, she is more confident at handling longer pieces of writing, and there has been some improvement in sentence structure.

Laura was observed on 3 occasions: 21 July and 4 November in 1986, and 26 June 1987. At first, Laura was self-conscious and nervous, and "did not appear very confident about what she was doing". On the second occasion, she was more confident: "Laura did not appear to have any problems while composing her story, the ideas seemed to flow at a steady rate in a business-like fashion." Interestingly, Laura focused only on one sentence at a time: "Any reading was restricted to the last sentence; she never did start reading it (i.e., the whole story) through from the beginning." For the last observation, apart from reluctance to use the spell checker, she used the new version of Fulltext well, "rarely needing to hunt for prompts on the screen as to what to do next":

> Laura appeared much more confident than in previous observations, prepared to discuss matters without shyness or nervousness. While composing text she took her inspiration from reading the previous few sentences and then typing away without pauses. . . . Whilst composing text, Laura did not bother to worry about spelling, preferring to keep the words flowing. Spelling was looked at later.

Her typing speed was estimated at 10-12 words per minute at the end of 1986, and 13 per minute by mid-1987, using 2 fingers of each hand.

Eric (Form 1-2)

Eric's 1986 diary was in 2 sections: "Description of Activity" (31 brief entries about the computer sessions, e.g., "Today I was doing my story I just started." [3.6.86]) and "Computer Diary" (21 entries of a more reflective nature, e.g., "I enjoyed using the computer today" [15.4.86]), though without saying why, and some comments about pupils he had helped or who had helped him (e.g., "Today I was doing my story about Twizel it was about my four days in Twizel, I helped martain [*sic*] but nobody helped me." [23.9.86]).

During 1987 he made 36 entries, mostly brief statements about printing, starting, finishing, or writing a story, e.g., "today we were writing a story about Ghost Rider" (25.2.87), with occasional remarks about helping another pupil, e.g., "today I helped Gordon to use the dictionary" (5.3.86).

Eric's views on writing changed little during the study. He liked talking about his writing with friends and let others read it to make suggestions and claimed to check his writing for spelling mistakes. However, at the end of the study he said he wrote a lot at home, though not at the beginning. Writing was not his favourite school activity. In 1986 he was unsure whether he liked discussing his writing with his teacher, but at the end of the study stated that he did, and also appeared to be more confident about his spelling. He agreed that he did not like having to think about punctuation (borne out by his writing samples), that he did not make many drafts or changes.

The first marking panel thought that Eric's handwritten letters had improved between February and November 1986, with better sentence structure, organisation, and more detail. The last letter (July 1987) shows an awareness of the potential reader (a pen-pal). It is divided into several short paragraphs which flow well as the ideas develop what has gone before. Eric's language use has improved too - sentences are more complex - as well as his use of punctuation, and there are fewer spelling mistakes.

The descriptive pieces from 1986 (there is not one from mid-1987) show some evidence of improvement in punctuation, for example, from no capitals and simple vocabulary to better punctuation and use of capitals (though not all in the right places) with fewer spelling mistakes. However, there is a sense of the writer's personality coming through, and the content is not uninteresting.

Eric's first 1986 story is poorly focused, beginning with a description of the dog having a bath, then jumping to the conclusion when the dog wins first prize at the local show; it is a single paragraph with several run-on sentences, simple vocabulary, and several spelling mistakes. The second story does not appear to have been revised (apart from words crossed out while the text was being composed), with overused words, confused tenses, run-on sentences, and misspellings evident throughout, though the final one is better organised and presented; sentence structure, punctuation, and spelling have all improved.

With respect to using the word processor, at the start of 1986 and by the end of the study he did not like discussing his writing with friends after using the word processor, nor did he help other pupils with their word processing. However, by the middle of the study, he had done both, and thought that the word processor was helping to improve his spelling, though he became more uncertain at the end. He did not enjoy writing more at the end of the study because of the word processor, and while he thought everyone should learn to write with a word processor when the study began, he became less certain as the study progressed. At no time was writing with the word processor his favourite school activ..

He consistently preferred neither word-processed nor pen(cil)-and paper-writing. He claimed to do more spelling corrections at the end of 1986 and to add or remove whole sentences a few times, compared to none at all at the start of 1986. By July 1987 he was back to making very few changes except to cosmetic aspects such as spelling, punctuation, and choice of words. Eric became more enthusiastic about using the word processor over the first year, but by the middle of the second year had reverted to his original views.

The word-processed pieces during 1986 contained poorly developed ideas (largely derivative) on the whole, and uncertain sentence structure; however, by the end of the year there appeared to be some growth in the control of mechanics, sentences, and paragraph structure. The pieces show a wider choice of vocabulary (e.g., "taxidermist"), and more detailed description, but run-on sentences and misspellings are frequent, as in Eric's other pieces of writing in 1986.

Some of the 1987 pieces are fast-paced action stories, possibly derived from television or videos, with lots of suspense, death and destruction, and occasional dialogue. Most of the sentences are poorly structured and punctuated. However, there are fewer spelling mistakes, and some improvement in paragraphing, particularly in the second piece. The final piece, about 3 months later (September 1987), "Zit" is markedly different. It is about 650 words in length (edited here to 220), and neatly presented in an italic script with numerous paragraphs. The story describes the author's affection for a little dog called Zit, its disappearance and death, and the acquisition of another puppy. It is a simple tale, with simple vocabulary, but holds the reader's attention, shows an eye for little details (e.g., "Zit loved lying under the old plum tree when it was spring"), and displays a much greater accuracy of language use than his earlier efforts.

Zit

The light shone through the window as Andy drew the curtains with little puppy dogs on it.Andy got dresssed, ran down stairs, picked up the bucket with scraps in it and ran down to the pig sty to feed the pigs.When Andy finished feeding the pigs he then ran down to the dog kennels to feed the dogs.....

Jill had five little baby pups. They were all black all except one who had a little white spot on its nose.Andy sprinted back to the gate closed it and then sprinted back home.He flicked his gumboots off his feet, and then ran inside to tell his dad that Jill had had pups.

Andy called the little black pup 'Zit' because of the little white spot on its nose.
Zit's grew up to be a strong and healthy farm dog and he won a few prizes for being the most intelligent dog in the side shows....

Andy woke up woke up at six in the morning, he then ran over to the bed that Kylie was sleeping in and started shaking him.
"What do you want".
"Hurry, get up we have to look for Zit and Ginger".
"It doesn't matter your dads found them".

"Whew I thought that they might be dead".
"They are Andy".Kyle said with a tear running down his cheek. Andy ran outside to the four wheel drive, he saw Zit and Ginger lying dead at the back of the truck flat, Andy walked back inside with head looking down at the ground, Andy the ran into the room and started sulking for a few minutes Kyle walked up to Andy. "How did you know about this".Andy answered with watery eyes. "Your dad walked in here and woke me up, he didn't want to tell you the bad news.Andy ran back to his bed and then jumped on it and started sulking again....

After the first year of the study, commentators on Eric's writing observed that there appeared to be some growth in the structure of sentences and paragraphs but little evidence of revision. However, by the middle of the next year (at the end of the study), he had improved his style and organisation, was more confident in developing ideas using more complex mechanical skills, and had improved in the use of computer layout techniques.

Observations of Eric using the computer were made 3 times: 16 July and 17 November in 1986, and 24 June 1987. By the end of the study, Eric was very confident at using Fulltext and did not encounter any difficulties while writing "as he had clearly thought out most of what he wanted to change before the lesson". He changed his text - he "had already printed a draft copy which he had corrected and so he was changing some words, correcting spelling and adding some sentences to his text" - but "his use of the proofreader did not result in any changes and 'alot' was accepted rather than make a change".

Eric had become more confident by the end of the study since, although he used appropriate procedures and had "no problem coming up with ideas for his stories", he had "difficulties typing them out" and was "not too concerned with spelling at the composing stage". These difficulties were less apparent by the end of the study, when most of his errors "seemed to be a result of trying to type quickly as the ideas for the story came faster than he could type them". In July 1986, "typing errors occurred so frequently he had to read the screen after each couple of words, on average, which slowed down the typing speed", and he "rarely put in any spaces after full stops or commas", "repeatedly began a sentence with a lower case letter" and "could not find the apostrophe key".

Eric's typing speed improved from 11 words a minute to 15 ("including imaginative guesses at spelling rather than reference to a dictionary") by the end of 1986. No estimate was provided in 1987.

5 TEACHING WRITING WITH A COMPUTER

In this section, comments are provided on the teachers' responses to the "Teaching Writing with the Word Processor" questionnaire, and trends in their attitudes. The commentary examines each teacher's views on the use of the word processor generally and, more specifically, in relation to writing with the word processor.

The Teachers

In 1986 four teachers were involved with the study. The standard 3 teacher was aged 37, in her tenth year of teaching with a bachelor's degree and primary teacher training, and had taught at a variety of levels up to form 2. The standard 4 teacher, a woman aged 55, had taught for about 25 years (mainly children between standard 1 and form 2), and had been trained as a primary teacher. The form 1-2 teacher, 26 years old, was in his fifth year of teaching, with a bachelor's degree and primary teacher training, and had taught at several levels between standard 1 and form 4. Finally, the form 3-4 teacher was 33, also in his tenth year of teaching, though a trained teacher without a degree, and had taught classes from standard 1 up to form 6. All, therefore, were experienced teachers who had taught at various levels.

In 1987 another teacher joined the study. The standard 3 teacher did not take part during 1987, and 1 of the form 1-3 teachers left for overseas before term 2, 1987 - he was also replaced for a few weeks by another teacher..

The Writing Environment*

During 1986, in the standard 3 class, pupils had a large degree of free choice in what they wrote within the "process writing" programme. None of their writing was formally graded, though comparisons involving an individual's work undertaken at different times of the year were made, and changes or problems discussed with that pupil (mainly ideas, grammar, and punctuation). Children's writing was often displayed on the wall, published as individual books, or retained in folders. Drafts produced on the word processor (largely done alone without teacher intervention) were discussed with the teacher if to be published.

In the standard 4 class, about two-thirds of the topics for writing were chosen by the pupils, and a list of topics was kept at the back of the classroom in case they were needed. Various approaches were used to teach writing, with much class discussion and the occasional formal language lesson. Teacher-pupil conferencing, proofreading, and displays of published writing were undertaken. Often, pupils' writing was discussed with them while they were composing at the computer. Evaluation focused upon qualitative features such as "interesting" sentences or choice of words, and marks or grades were not put on the pupils' writing.

In the form 1-2 class, about half of the topics for writing were chosen by the pupils, with the remainder directed by the teacher to varying degrees. A "process writing" approach was followed, with the teacher sometimes commenting while pupils were writing at the computer, often to point out mistakes. Drafts were written upon by the teacher, but final copies were not marked or graded. Pupils were able to choose themselves what to do with individual pieces of written work, as some liked to display it while others did not.

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* As information on the writing environments is based largely on first-hand observation of the teachers at regular intervals while pupils were using the word processors, and the principal researcher was overseas for much of the second year of the study, 1986 data only on the writing environment have been included in this section.

In the form 3-4 class, topics were chosen by the pupils about one-third of the time, with the remainder teacher-directed to varying degrees. While pupils were writing at the computer, teacher intervention occasionally occurred (e.g., mistakes were pointed out), and completed drafts were sometimes commented upon. Writing was graded (most of the work that was handed in to the teacher), but the grades reflected the teacher's perception of the pupil's performance rather than performance in relation to an ideal norm. This teacher thought that he had been influenced by the "process writing" approach, but did not follow it to the same extent as the other teachers.

Teacher A

The attitude of this standard 3 teacher towards the teaching of writing with a word processor was somewhat ambivalent. On one hand she saw its benefits as a stimulus to children whose abilities were hindered by poor handwriting skills. On the other hand, it was a hindrance to more capable children who were handicapped by their lack of typing skills and the frustration this caused to a normal flow of ideas. Teacher A personally did not enjoy using the word processor by the end of the first year of the study, but acknowledged that her pupils on the whole did. Spelling and writing performance in her view did not improve, but writing did not become more difficult for children as a result of using the computer. Most pupils enjoyed writing since they began using the word processor and it fitted in well with normal teaching. Finally, she wanted to see the computer in classrooms alongside conventional methods of teaching writing.

Teacher B

After 5 terms' involvement with the teaching of writing on the word processor, Teacher B remained positive towards its use as an extra tool in the teaching of "process writing" for standard 4 children. One area of difficulty was noted. Possibly due to the presence of a larger number of less able children in her classroom during 1986, this teacher stressed caution when teaching writing with a computer to lower ability groups who were still in need of help, and for whom the editing capabilities, including the spell check facility, were of little value. These pupils tended to believe that the computer had an almost magical quality of producing satisfactory work without the need for their own effort, with the computer itself viewed as an escape from the more arduous task of writing by hand. These fears were not restated in the final questionnaire (July 1987).

Teacher C

A latecomer to this study, Teacher C expressed a different, more critical perspective regarding the teaching of writing with a word processor. Concerned with its complexity for many learners, she pointed out that technical problems, availability, reduced speed, and lack of privacy caused classroom management problems, interruptions to the flow of ideas, frustration and, in many cases, made story writing more difficult than before. On the positive side, however, Teacher C was impressed with the level of positive co-operation promoted by the computer, the pride expressed by children with professionally finished work, the increased amount of editing and error detection that occurred and, at least with some children, not only an increase in the amount of output but visible improvements in written work as well. Teacher C was careful to point out that the benefits suit only certain individuals, while other children found the machine inhibiting and confusing. This sentiment was expressed by many teachers in the survey and requires further research.

Teacher D

Teacher D's attitude towards the teaching of writing on the word processor in his form 1-2 classroom was one of the most enthusiastic responses to the programme noted by the survey. He and his pupils experienced little difficulty in using the computer and he strongly supported the notion that it helped to improve students' written work both in quality and quantity. He believed that a high level of interest existed among his pupils

and that "those who enjoy writing can be extended to full potential". Other positive comments took into account the disks, which provided a good collection base, the new Fulltext program, which speeded up editing, and the benefits of having neat copies. He enjoyed his experience with the computer and would have liked to see the teaching of writing using a word processor continue alongside more conventional teaching methods.

Teacher E

Teacher E took over from Teacher D's form 1-2 class for the final term of the study, ending in July 1987. With the exception of 4 items in the questionnaire, this teacher's responses were very similar to D's. She believed that not everyone was suited to learning to use the word processor and was not sure whether typing skills needed to be improved in order to use it properly. She was also uncertain whether pupils became more interested in writing since they began writing in this way, although no evidence was available to test this claim. Finally and, perhaps, most important she did not believe that the word processor fitted in well with her normal teaching, although no explanation was offered to support this opinion.

Teacher F

The extended involvement of Teacher F in the study was unique when compared with most of the other teachers. In the first year he worked with a form 3-4 class, while in the second year (until July 1987) he worked with a form 1-2 class. This teacher's attitude towards the word processor appeared to be less enthusiastic and more sceptical than most of the other teachers. He noted that lack of typing skills was a problem for the students, as it hindered their flow of ideas during "process writing" sessions. He became convinced that the computer was not suitable for all students, and believed that it did not fit well with normal teaching. However, like his colleagues, he believed that the word processor had a role to play alongside more conventional instructional practices.

6 DID THE COMPUTERS IMPROVE THE PUPILS' WRITING?

One of the most beneficial outcomes for the pupils in this study was clearly the increase in motivation to write experienced by the word-processor writers, and the greater quantity of written work created. Previously reluctant pupils often became more productive, even if, according to their teacher, writing quality did not appear to improve. One piece of conventional wisdom suggests that the more one writes, the more opportunities exist for improvement, so it is possible that the gains experienced by some of the case-study pupils were a result of their writing with a word processor over 4 terms and 2 successive years.

Another positive outcome was the increased sharing of pupils' writing and the (generally) positive interaction fostered as a consequence in the classroom. Many pupils seemed to open up during the study, and to help their peers more than previously.

The Writers

The "Good" Writers

Three pupils (Sharon, Godfrey, and John) were chosen as "good" or competent writers. Of these, Sharon in particular appears to have emerged as an extremely capable writer over the period of the study, while the other 2, although reasonably competent, would perhaps more appropriately be placed in the next category.

Sharon had PAT scores well into the 90s, and appeared to be a gifted and perceptive child. In the first year, she thoroughly enjoyed writing and her control of language was considered "very impressive" by the evaluation panel, with complex vocabulary and well-organised pieces of writing. She extended her efforts at experimenting with written language, managing to sustain very imaginative ideas in increasingly longer pieces. However, this trend was not noticed in the second year, when her development appeared to reach a plateau, and her interest in writing began to wane. Whether this was due to the influence of the teacher in 1987 or other factors is difficult to ascertain.

She was aware of her own writing and thinking processes, and regularly helped other pupils. She appeared to make fewer changes to her writing towards the end of the first year, and after mid-1986 no longer considered writing with the word processor to be her favourite activity (which she had stated earlier). Her views about the usefulness of the word processor were more equivocal as judged by her questionnaire responses. She had no special preference for word-processed writing over longhand writing. However, it is important to remember that this pupil was an extremely able writer and competent with the word processor. It is possible that the word processor, at least initially, boosted this writer by giving her the freedom to experiment with language to a greater extent than she might have done without the computer, but that once she had been exposed to writing on the computer her natural ability was not enhanced by continued use of the different technology.

The other 2 pupils were both males, 1 from standard 3 with above-average PAT scores and very competent at reading, the other from form 2 and generally of above-average attainment. It is difficult to tell whether either of these pupils improved significantly as writers during the course of the year. Godfrey's word-processed writing was more detailed towards the close of the first year, but language usage was consistent throughout the study. He enjoyed writing with the word processor, but he did not think it was helping to improve his spelling, and was unsure whether it was helping to improve his writing over all. He preferred to do all his writing on the word processor, however, throughout the study.

Michael's word-processed writing was technically sound (the final copies at least), but there may have been a slight regression in the development of topics and use of vocabulary by the end of 1986. However, his writing in 1987 had improved in style, use of language, and paragraphing. He appears to have become more disenchanted with writing as the first year went by, having enjoyed using the word processor at first,

but not so later on, though he was more positive by the time the study ended. He thought that his spelling and writing were generally improving over the first year, although he had no special preference for either word-processed or longhand writing.

The "Average" Writers

Three pupils (Laura, Sean, and Teri) were chosen in this category, and 2 of these were female. All seemed to have improved in some respect during the course of the study; but it is difficult to determine to what extent the use of the word processor was responsible.

Laura increased the length of her writing by the end of the year, and maintained this trend into the second year, but throughout - with both word-processed and longhand pieces - had a large number of language inaccuracies in her writing. She did not seem to proofread, particularly in the first year. She was unsure whether the word processor was helping to improve her spelling, but she did think that her writing was improving because she used a word processor. She had no special preference for either word-processed or longhand writing. However, by the end of the study her sense of paragraphing and sentence structure appeared to have improved.

Sean appeared to improve both the quantity and quality of his sentences over the first year, and the presentation of his writing. However, there was little evidence of expansion of ideas or vocabulary, apart from some progress with vocabulary in the second year. By the end of the study his organisation appeared to have deteriorated, and while his word-processed pieces were longer, his editing was poor. Nevertheless, he enjoyed writing with the word processor and thought that his writing was getting better because he was using it. He had no special preference for either word-processed or longhand writing.

Teri wrote simply, with little development of ideas, and several language inaccuracies in each piece. Initially her word-processed pieces varied in quality, and while the pieces produced later in the first year have a more complex sentence structure they showed little development in their ideas. All her pieces were very short, with no increase in length; this was a feature of her writing in the second year also. However, over the 18 months, her writing exhibited more control and appeared to be better organised, and more carefully proofread. She thought that writing on the word processor was fun, but was unsure whether she enjoyed writing with it. However, she was of the view that her spelling was improving. She had no special preference for either word-processed or longhand writing.

The Writers "Experiencing Difficulties"

Three pupils, all males, were chosen in this category. As with the previous group, all seem to have improved during the course of the study in at least one respect.

Initially Eric wrote poorly focused pieces, with simple vocabulary and a large number of inaccuracies in language usage. On the whole his word-processed pieces were poor in ideas. However, by the end of the first year there appeared to be some growth in the control of mechanics, and sentence and paragraph structure. By the end of the study the style and organisation of his writing had improved, and he was revising his work more successfully, with improved layout. By the end of the first year he thought that the word processor was helping to improve his spelling. However, he had no special preference for either word-processed or longhand writing throughout the study.

Thomas's writing at the beginning of the year was simple in content, but reasonably accurate in sentence structure and language usage. By the end of the first year his writing was much longer and more complex in content, although other changes in his word-processed pieces were not detected. By the end of the study, his accuracy of language use and variety of sentence structure had improved, but not organisation, and he appeared to be taking more risks when using the word processor. He enjoyed using the word processor and liked making changes to his writing. He thought his writing was getting better because he used the word processor but was uncertain whether his spelling was improving. He had no special preference for either

word-processed or longhand writing part way through the study but by the end preferred to do all his writing on the word processor.

Michael at the beginning of the study wrote simply, with sparse content and vocabulary, and his pieces lacked organisation. During the first year, apart from increasing in length, the word-processed pieces showed few signs of development, although the 2 final copies were punctuated more accurately. By the end of the study, there appeared to be some improvement, with greater sentence variety, ideas more germane to the topics set, and better control over surface conventions. He enjoyed using the word processor and claimed that he liked making changes to his writing. Throughout the study he also thought that his writing was getting better because he used the word processor, and that it was helping to improve his spelling. He preferred to do all his writing on a word processor.

Summary

Of all the case-study pupils, representing a wide range of achievement in writing; none preferred to write only in longhand. Although the majority had no special preference for either word-processed or pen(cil)-and-paper writing, a small number did prefer to use the word processor solely. With one exception, all still enjoyed writing with the word processor by the end of the study, and nearly all agreed that the computer was helping to improve their writing. If the comments of the evaluation panels are an accurate reflection of developmental changes in the pupils' written work, then all but 2 showed some positive changes over the course of the study.

The Teachers (1986)

The survey of 4 teachers' perceptions of the usefulness of the word processor for teaching writing conducted twice in 1986 showed a reasonably similar, positive series of responses. The teachers in classes ranging from standard 3 to form 4 noted that most of their students enjoyed their experience with the word processor and using it to compose written material. In most cases the teachers themselves enjoyed using the computer and, like their students, claimed that they had little difficulty with it. All of the teachers agreed that there were positive aspects to writing with a word processor. Written work had not become more difficult for most children, some improvements were noted, and some pupils were producing longer pieces of writing. Features such as the editing facility and the neat, professional quality of the printed output enhanced proofreading and correcting, and boosted the students' enthusiasm towards writing.

Although this survey found some positive consequences of using a word processor, further research will be necessary. For instance, each teacher was assigned distinctly different grades or classes of pupils. Therefore an investigation of the reactions of a *number* of teachers at the *same* age and/or ability levels may be necessary to establish whether there are any significant differences in the use of the computer for writing by children at different age levels and among other groups within the total sample. Secondly, the sample used in this study is too small to draw any firm conclusions regarding the reactions of the teaching profession as a whole, or even rural teachers. Finally, since they were working in the same school, intervening variables such as discussion among the teachers or common experiences arising from school-wide development activities may also have influenced the results to produce a relatively stable pattern of responses and opinions, leading perhaps to misleading conclusions.

Over all, however, these results from a small group of teachers at various class levels paint a promising picture for the teaching of writing with computers.

Spelling

Perhaps the major problem was the computer dictionary and its effect on pupils' proofreading habits. At all levels, lack of effective proofreading resulted in large numbers of incorrect words, inappropriate punctuation, and misuse of capital letters. According to the 1986 standard 3 teacher, the "main problem seems to be that

they don't recognise the spelling errors in the first place", while the 1986 standard 4 teacher suggested that the pupils "think that the computer dictionary is a panacea for all their woes". She was of the view that "the very weak spellers are not helped by the spelling checkers, as they have very little idea of anything other than the beginning letter", and was convinced that the use of the computer dictionary made very little if any difference at all to the quality of spelling in her class. She considered that it was used as a crutch rather than as a positive learning aid: "The spelling checker is a list of words, not a dictionary. While it can pick up incorrect spelling, it cannot detect incorrect usage (e.g., 'rode' for 'road')." Occasionally, too, it did not show words in alphabetical order.

There appear to be 2 problems here, though they are closely connected: firstly, the computer dictionary or spelling checker was not very sophisticated and was of limited usefulness, especially to writers experiencing difficulties with spelling; secondly, pupils who were not consistent proofreaders of their own writing were not likely to become competent editors simply because they had access to a computer dictionary. This finding confirms Macarthur's (1988) observation (p. 540) that

> . . . further development of software designed for educational purposes, and of instructional methods, will be needed before computer analysis of writing will be helpful to beginning writers. Students can use spelling checkers to compensate for poor spelling skills, but current software was not designed to help students develop spelling skills.

Another problem - though not seen as such by all teachers - was the sheer volume of writing produced by some pupils. As they became more confident in using the computer, many pupils began to generate much longer pieces of writing, a finding consistent with other research (*see,* for example, Morton, Lindsay, and Roche, 1989). As a result, early in the second term one teacher said: "Got into a shambles. Too many kids printing. Not enough time to assist those on keyboards, and read through drafts, and peruse final copies. Somehow . . . quantity seems to be more important than quality to a number of kids." Another teacher was alarmed by the apparent increase in errors as "below average" children began to write more, producing "pages of rubbish with so many mistakes that (the pupil) gets bored p ofreading and begins a new story".

Conclusion

Some important trends developed as the study progressed.

- The majority of case-study pupils retained very positive attitudes towards writing with the word processor, and many seemed to enjoy writing more at the end of the first year of the study than at the beginning of the year - some retained this enthusiasm through to the end of the study.

- Some aspects of some of the case-study pupils' writing improved over the first year, e.g., length, and possibly related to this, number of ideas and variety of sentence structure. However, the same kinds of change were not apparent with all the case-study pupils, and with some pupils the changes which occurred were confined to only one aspect of their writing.

- The spelling check/computer dictionary program appeared to make little difference to the quality of spelling used by the case-study pupils. While specific analytic measures (e.g., estimates of vocabulary difficulty, or changes in the frequency of misspelt words over the year) could possibly have indicated whether spelling improvement had occurred, they were not used because of the excessive amount of time which would be required to undertake such analyses, and because such quantitative measures alone make no allowance for the context in which misspellings occur.

During the second year of the study, these trends continued, but were not even for all students. It is possible that, for some of the case-study pupils, their writing development on the word processor did not continue its smooth improvement due to change of teachers. This is consistent with Daiute's (1985) observation that the computer makes little difference for some students or is limiting for others. As has been shown, despite overall gains in some aspects of writing within a specified period of time for a particular pupil, these gains were not always maintained.

As to why these changes have come about, a number of interpretations are possible. It is likely, for example, that the extra attention given to writing by the teachers in the experimental classes in itself encouraged some of the pupils to think more carefully about their written work, or to follow procedures which they had not previously adopted. It is also possible that the teachers themselves acquired different strategies for teaching writing during the first year as a result of their experiences with the word processor and that, in the second year, usually with a different group of students, they were able to help their pupils to improve their written work in new ways. It is also possible that maturation in the pupils contributed to their growth as writers in some instances, although this does not explain the decline shown in Sharon's writing.

However, there do not appear to have been any significant negative results from the study, except for the single disenchanted pupil (whose dissatisfaction with writing may have arisen from events quite independent of his use of the word processor).

It is highly likely, therefore, that the use of the word processor in this school was an important factor - but not the only factor - in developing the case-study pupils' writing skills. Variations among pupils in their attitudes and achievement may reflect factors such as teacher personality and preferred mode of curriculum delivery, interest in the application of computers in learning, and personal commitment to their own use of computers, pupil motivation, relationships with peers, and so on - all the features which make up the complex fabric of the classroom.

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APPENDICES

Appendix A: The "Attitudes Towards Writing" Questionnaire

WHAT DO YOU THINK ABOUT WRITING?

This questionnaire asks you about how you write at school and what you think of your own writing. Please complete the information about yourself first.

Name: _____
(first) (last)

School: _____

Class: _____ Age: _____years _____months

Boy [ ] Girl [ ] (please tick)

All of the questions inside may be answered by ticking a box [✓].
Try these examples first.

Examples

		Yes	Not sure	No
A.	Do you like writing letters?	[ ]	[ ]	[ ]
B.	Do you write at school every day?	[ ]	[ ]	[ ]

		I agree	I am not sure	I disagree
C.	I get lots of ideas for writing from reading the newspaper	[ ]	[ ]	[ ]
D.	Reading is more fun than writing	[ ]	[ ]	[ ]

Please work carefully so that you do not miss anything out.
Now go ahead with the questions inside.

Part 1 How do you write?

To answer this question please tick one box [✓] alongside each statement.

		Yes	Not sure	No
1.	Do you write a lot at school?	[ ]	[ ]	[ ]
2.	Do you write a lot at home?	[ ]	[ ]	[ ]
3.	Do you keep a diary?	[ ]	[ ]	[ ]
4.	Do you write letters sometimes to friends or relatives?	[ ]	[ ]	[ ]
5.	Do you write lots of stories at school?	[ ]	[ ]	[ ]
6.	Do you choose your own topics to write about?	[ ]	[ ]	[ ]
7.	Before you start writing, do you share your ideas with your friends?	[ ]	[ ]	[ ]
8.	Do you get lots of good ideas to write about from watching T.V.?	[ ]	[ ]	[ ]
9.	Do you plan your writing or make notes before you start?	[ ]	[ ]	[ ]
10.	Do you usually run out of ideas when you are writing a story?	[ ]	[ ]	[ ]
11.	Do you do any writing at home which you don't show to anyone else?	[ ]	[ ]	[ ]
12.	Can you write for a long time without getting bored?	[ ]	[ ]	[ ]
13.	While you are writing, do you talk about it with your friends?	[ ]	[ ]	[ ]
14.	Do you get lots of ideas for your writing from books?	[ ]	[ ]	[ ]
15.	Do you have writing conferences with your teacher?	[ ]	[ ]	[ ]
16.	Do you put off starting to write for as long as possible?	[ ]	[ ]	[ ]
17.	Do you find it hard to write as much as your teacher wants?	[ ]	[ ]	[ ]
18.	Is your handwriting neat and easy to read?	[ ]	[ ]	[ ]
19.	Do you let other people read your writing to make suggestions about it?	[ ]	[ ]	[ ]

		Yes	Not sure	No
20.	Do you look through your writing to find spelling mistakes?	[ ]	[ ]	[ ]
21.	Do you sometimes have trouble thinking of the right words to put down when you are writing?	[ ]	[ ]	[ ]
22.	When you are writing a story, do you write a draft first?	[ ]	[ ]	[ ]
23.	If you answered 'Yes' to question 22: Do you change many parts of your writing when you have written your first draft?	[ ]	[ ]	[ ]
24.	Do you publish any of your stories?	[ ]	[ ]	[ ]
25.	Are any of your stories kept in the classroom library?	[ ]	[ ]	[ ]
26.	Do you look up a dictionary to check the spelling of words you are unsure of?	[ ]	[ ]	[ ]
27.	Does your mind wander when you are writing?	[ ]	[ ]	[ ]
28.	Do you ever feel rushed to finish writing?	[ ]	[ ]	[ ]
29.	Is writing your favourite activity at school?	[ ]	[ ]	[ ]
30.	Do you write long stories sometimes?	[ ]	[ ]	[ ]

Part 2 What do you think about your own writing?

Please tick one box [✓] alongside each statement to show whether you agree, are not sure, or disagree.

	I agree	I am not sure	I disagree
1. I think I am quite good at writing.	[ ]	[ ]	[ ]
2. I like talking to my friends about my own writing.	[ ]	[ ]	[ ]
3. I like helping my friends to improve their writing.	[ ]	[ ]	[ ]
4. I only do writing when I have to.	[ ]	[ ]	[ ]
5. I think that copying notes from the blackboard is a waste of time.	[ ]	[ ]	[ ]
6. I enjoy discussing my writing with my teacher.	[ ]	[ ]	[ ]
7. Whenever I have to write something, I try to use as few words as possible.	[ ]	[ ]	[ ]
8. It is very helpful to me if other people read my writing and tell me what they think of it.	[ ]	[ ]	[ ]
9. I enjoy writing stories most of all.	[ ]	[ ]	[ ]
10. I don't like having to worry about where to put all the commas and fullstops in writing.	[ ]	[ ]	[ ]
11. My writing is untidy sometimes.	[ ]	[ ]	[ ]
12. The kind of writing I like best is when I write about something which really interests me.	[ ]	[ ]	[ ]
13. I enjoy looking over my writing trying to improve it.	[ ]	[ ]	[ ]
14. I enjoy decorating headings and drawing pictures to go with my writing.	[ ]	[ ]	[ ]
15. Before I am satisfied with my writing I do lots of drafts and make lots of changes.	[ ]	[ ]	[ ]
16. I think writing is a waste of time.	[ ]	[ ]	[ ]

		I agree	I am not sure	I disagree
17.	On some days I like writing, but on other days I don't like it.	[ ]	[ ]	[ ]
18.	Writing helps me to learn more.	[ ]	[ ]	[ ]
19.	When I have written something down, I prefer not to change it.	[ ]	[ ]	[ ]
20.	I am not a very good speller.	[ ]	[ ]	[ ]

THANK YOU FOR YOUR HELP

Appendix B: The "Writing with a Word Processor"Questionnaire

DO YOU LIKE WRITING WITH A WORD PROCESSOR?

This questionnaire asks you about what it is like to write with a word processor (computer). Please complete the information about yourself first.

Name: _____
(first) (last)

School: _____

Class: _____ Age: _____years _____months

Boy [ ] Girl [ ] (please tick)

Most of the questions inside may be answered by ticking a box [✓]. Try these examples first.

Examples

	Yes	Not sure	No
A. I use the word processor every day.	[ ]	[ ]	[ ]
B. The word processor is very useful for writing.	[ ]	[ ]	[ ]

For other questions, you will need to write your ideas down on the lines provided.

Please note: When the word writing is used it means language writing or story writing. It does not mean handwriting.

Please work carefully so that you do not miss anything out.
Now go ahead with the questions inside.

Part 1 What do you think about writing with a word processor?

		Yes	Not sure	No
1.	I enjoy writing with a word processor.	[ ]	[ ]	[ ]
2.	I like discussing my writing with friends after using the word processor.	[ ]	[ ]	[ ]
3.	I often need help from the teacher when I am using the word processor.	[ ]	[ ]	[ ]
4.	I help other pupils in the class with their writing when they are using the word processor.	[ ]	[ ]	[ ]
5.	I think that writing is fun on the word processor.	[ ]	[ ]	[ ]
6.	Whenever I use the word processor I try to use as few words as possible.	[ ]	[ ]	[ ]
7.	I enjoy writing stories on the word processor.	[ ]	[ ]	[ ]
8.	I like making changes to my writing when I am using the word processor.	[ ]	[ ]	[ ]
9.	One of the best things about the word processor is that it prints writing neatly.	[ ]	[ ]	[ ]
10.	I often get help from my friends when I am using the word processor.	[ ]	[ ]	[ ]
11.	The word processor makes writing a lot easier.	[ ]	[ ]	[ ]
12.	I think that writing with the word processor is a waste of time.	[ ]	[ ]	[ ]
13.	On some days I like writing with the word processor but on other days I don't like using it.	[ ]	[ ]	[ ]
14.	I think my writing is getting better because I use a word processor.	[ ]	[ ]	[ ]
15.	When I have written something on the word processor I do not like changing it.	[ ]	[ ]	[ ]
16.	I think the word processor is helping to improve my spelling.	[ ]	[ ]	[ ]
17.	I enjoy writing a lot more than I used to, because I use the word processor.	[ ]	[ ]	[ ]
18.	Writing with the word processor is my favourite activity at school.	[ ]	[ ]	[ ]

	Yes	Not sure	No
19. I think that the word processor is difficult to use.	[ ]	[ ]	[ ]
20. Sometimes I forget what I'm doing when I use the word processor.	[ ]	[ ]	[ ]
21. I need to improve my typing so that I can use the word processor more easily.	[ ]	[ ]	[ ]
22. I can write for a long time on the word processor without feeling tired.	[ ]	[ ]	[ ]
23. I usually change my story after I've printed it out for the first time.	[ ]	[ ]	[ ]
24. While I am writing on the word processor, I get lots of good ideas for my stories.	[ ]	[ ]	[ ]
25. When I am using the word processor I try to put off starting to write for as long as possible.	[ ]	[ ]	[ ]
26. When I am writing with the word processor I sometimes have trouble thinking of the right words to put down.	[ ]	[ ]	[ ]
27. I like letting other people see the writing I have done on the word processor.	[ ]	[ ]	[ ]
28. I am good at typing on the word processor.	[ ]	[ ]	[ ]
29. I think everyone should learn to write with a word processor.	[ ]	[ ]	[ ]
30. I like writing my ideas down with pen and paper before I use the word processor.	[ ]	[ ]	[ ]
31. Sometimes I add or remove large parts of my story when I'm using the word processor.	[ ]	[ ]	[ ]
32. I enjoy adding and removing words from my stories with the word processor.	[ ]	[ ]	[ ]

Part 2 How do you use the word processor?

33. What are the things you like best about writing with a word processor?

34. What are the things you do not like about writing with a word processor?

35. What are the things you like best about writing with a pen (or pencil) and paper?

36. What are the things you do not like about writing with a pen (or pencil) and paper?

37. Please tick one of these boxes:

I would like to do all my writing on a word processor. [ ]

I would like to do all my writing with a pen (or pencil) and paper. [ ]

I would like to do some writing with a word processor and some with a pen (or pencil) and paper. [ ]

38. When you wrote your last story with the word processor, how many changes did you make before it was finished?

Please tick one of these boxes:

I didn't make any changes. [ ]

I made a few changes. [ ]

I made lots of changes. [ ]

39. What changes did you make to your last story?

Please tick one of the boxes for each line:

	A lot of times	A few times	Not at all
I corrected my spelling	[ ]	[ ]	[ ]
I changed some commas and fullstops	[ ]	[ ]	[ ]
I added or removed some words	[ ]	[ ]	[ ]
I added or removed whole sentences	[ ]	[ ]	[ ]
I added or removed large parts	[ ]	[ ]	[ ]

40. How much have you learned about using the word processor from these people? Please tick one of the boxes for each line:

	A lot of things	A few things	Nothing
Your teacher	[ ]	[ ]	[ ]
Your classmates or friends	[ ]	[ ]	[ ]
Just using it yourself	[ ]	[ ]	[ ]

THANK YOU FOR YOUR HELP

Appendix C: The "Teaching Writing with a Word Processor" Questionnaire

TEACHING WRITING WITH A WORD PROCESSOR

(Teaching Writing: Questionnaire B)

Name: _____

School: _____

Class: _____

This questionnaire contains a number of questions on the role of the word processor in your classroom, and is designed to complement the comments in your diary. You will need only a few minutes to complete it. Please forward your completed questionnaire to your computer study's co-ordinator.

Please tick the appropriate column in answering the following questions.

		I strongly agree	I agree	I am not sure	I disagree	I strongly disagree
1.	The word processor has helped my pupils to improve their written work.	[ ]	[ ]	[ ]	[ ]	[ ]
2.	I enjoy using the word processor myself.	[ ]	[ ]	[ ]	[ ]	[ ]
3.	A lot of my pupils enjoy using the word processor.	[ ]	[ ]	[ ]	[ ]	[ ]
4.	I have to give some pupils a great deal of help in order to use the word processor properly.	[ ]	[ ]	[ ]	[ ]	[ ]
5.	Some of my pupils have become more interested in writing since they began to use the word processor.	[ ]	[ ]	[ ]	[ ]	[ ]
6.	The word processor makes writing a lot easier.	[ ]	[ ]	[ ]	[ ]	[ ]
7.	The word processor is helping to improve the spelling of some of my pupils.	[ ]	[ ]	[ ]	[ ]	[ ]

		I strongly agree	I agree	I am not sure	I disagree	I strongly disagree
8.	Some of my pupils are doing longer pieces of writing now that they are using the word processor.	[ ]	[ ]	[ ]	[ ]	[ ]
9.	Some of my pupils need to improve their typing more so that they can use the word processor properly.	[ ]	[ ]	[ ]	[ ]	[ ]
10.	I think everyone should learn to write with a word processor.	[ ]	[ ]	[ ]	[ ]	[ ]
11.	I think that the word processor is difficult to use.	[ ]	[ ]	[ ]	[ ]	[ ]
12.	Most of my pupils enjoy writing stories on the word processor.	[ ]	[ ]	[ ]	[ ]	[ ]
13.	The word processor has fitted in well with my normal teaching.	[ ]	[ ]	[ ]	[ ]	[ ]
14.	I would like to have more guidance on the use of the word processor.	[ ]	[ ]	[ ]	[ ]	[ ]
15.	Some of my pupils have more difficulties with writing now that they are using the word processor than they did before.	[ ]	[ ]	[ ]	[ ]	[ ]

16. Please tick one of the following boxes.

I would like my pupils to do all their writing on the word processor. [ ]

I would like my pupils to do all their writing with a pen(cil) and paper. [ ]

I would like my pupils to do some writing with the word processor and some with a pen(cil) and paper. [ ]

17. Please list the advantages (if any) that you consider the word processor brings to the teaching of writing.

18. Please list the disadvantages (if any) that you consider the word processor brings to the teaching of writing.

THANK YOU FOR YOUR HELP

Appendix D: Pupil Diary

Keeping Your Computer Diary

1 When you use the computer, or whenever you want to write about your feelings to do with computers, fill in your diary.

2 You can make a diary out of a notebook, exercise book or folder. Just write the date and the comments you want to make.

3 Here are some things you might like to write about:

a Did you enjoy using the computer today?
Were you able to do what you wanted to?

b Did you have any problems? What went wrong?
Did you work out what you had to do in the end?

c Did anyone work with you on the computer?
What help were you given?
Did you help anyone else?
What sort of help did you give?

d What can you do on the computer that you cannot do any other way?
Do you prefer using the computer compared to other ways of doing things?

e Keep a brief account of the different sorts of things you use the computer for, and see if you improve your skill from week to week or month to month. Can you tell if you are getting better?

4 Make sure you rule off after each time you write in your diary.

Appendix E: Observation Guide for Case-study Pupils

NB Summary of Items

1 Assistance given to the pupil

2 Assistance given by the pupil to another pupil

3 Time spent on-task and off-task

4 Changes made

5 Matters of presentation

6 Confidence in the use of word-processing procedures

7 Comments made by the pupil while writing

8 Use of the computer log

9 Speed of writing

10 Difficulties encountered while writing